4. Affected Environment and Environmental Consequences

Section 4 describes the existing conditions of the natural and human environments that would potentially be affected by the proposed project. Direct impacts associated with the *Build Alternatives* as well as the *No Build Alternative* are analyzed for each resource or condition. Encroachment-alteration effects that may result from the *Build Alternatives* are also discussed for each resource or condition. Encroachment-alteration effects are a type of indirect impact, removed from the proposed project in both time and distance, and are defined as those impacts that alter the behavior and functioning of the physical environment. Direct impacts are assessed in an area applicable to the resource being studied; such areas are described, where applicable, in specific resource sections.

4.1 Resources Eliminated from Further Study

The following issues were evaluated and found not to have any bearings on the proposed project and would not affect a decision regarding the proposed project:

- Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1966
- Section 6(f) of the Land and Water Conservation Act
- Chapter 26 of the Parks and Wildlife Code
- Airway-highway clearance
- U.S. Coast Guard permits
- Coastal zone management and coastal barriers
- Magnuson-Stevens Fishery Conservation and Management Act
- Marine Mammal Protection Act
- Bald and Golden Eagle Protection Act
- Trinity River Corridor Development Certification
- International Boundary and Water Commission
- Wild and scenic rivers
- Native American Concerns

4.1.1 Section 4(f) of the DOT Act of 1966

The DOT Act of 1966 includes a special provision, Section 4(f), stipulating that DOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historic sites unless the following conditions apply:

- there is no feasible and prudent avoidance alternative to the use of land, and the action includes all possible planning to minimize harm to the property resulting from such use; or
- the administration determines that the use of the property will have a *de minimis* impact.

Alternative A would require the acquisition of approximately 74.58 acres of right-of-way from 80 parcels and *Alternative C* would require the acquisition of approximately 75.19 acres of right-of-way from 87 parcels. The proposed *Build Alternatives* would not impact land from any publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historic sites. Therefore, Section 4(f) approval requirements do not apply.

4.1.2 Section 6(f) of the Land and Water Conservation Act

Section 6(f) of the Land and Water Conservation Act prohibits the conversion of property acquired or developed with Land and Water Conservation Fund Act grants to uses other than public outdoor recreation without the approval of the Department of the Interior's National Park Service. No park or recreational land would be converted to transportation use with the proposed project; therefore, Section 6(f) does not apply.

4.1.3 Chapter 26 of the Parks and Wildlife Code

Chapter 26 of the Parks and Wildlife Code regulates the transportation use of any public land used as a park, recreation area, scientific area, wildlife refuge, or historic site. Chapter 26 would not apply because the proposed project would not affect any public parks, recreation areas, scientific areas, wildlife refuges, or historic sites.

4.1.4 Airway-Highway Clearance

No airports or heliports open to the public or operated by an armed force of the U.S. were identified within 2 miles of the proposed project. The St. David's South Austin Hospital helipad is located approximately 3 miles east of the project corridor and is not a military facility or open to the public. Therefore, airway-highway clearance need not be obtained.

4.1.5 U.S. Coast Guard Permits

No U.S. Coast Guard permits are considered necessary for this proposed project because no navigable waters as defined by the General Bridge Act of 1946 would be crossed.

4.1.6 Coastal Zone Management and Coastal Barriers

The Coastal Zone Management Act (CZMA) of 1972, as amended in 1996, provides for the preservation, protection, development, and where feasible, restoration and enhancement of the nation's coastal zone resources. In Texas, the General Land Office (GLO) is designated as the lead agency that coordinates the development and implementation of the Texas Coastal Management Plan (TCMP). The Coastal Coordination Council administers the coastal management program and is in charge of adopting uniform goals and policies to guide decision-making by all entities regulating or managing natural resource use within the Texas coastal area.

The boundary of the Texas coastal management zone (CMZ) was delineated in accordance with the requirements of the federal CZMA, federal program development and approval regulations, and the Texas Coastal Coordination Act. Requirements dictate that a state's coastal zone boundaries include four elements: inland boundary, seaward boundary, interstate boundaries, and federal land excluded from the boundary. The proposed project is located in Travis County, which is not a coastal county, and no formal coordination with the GLO would be required.

The Coastal Barrier Resource Act was passed in 1982 to address potential impacts to coastal barriers caused by development. The OHP Project corridor is not mapped as part of the nation's coastal barrier resources system; therefore, coastal barrier resources would not be impacted.

4.1.7 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), first enacted in 1976 then reauthorized in 2006, requires that essential fish habitat (EFH) be identified for all federally managed fisheries. The OHP Project area is not located within a county that has tidally influenced water bodies, which means there are also no EFH mapped within Travis County. Therefore, the project is not subject to the MSFCMA and would not impact EFH as defined by 16 U.S. Code (U.S.C.) 1802.

4.1.8 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) was enacted on October 21, 1972, and amended in 1994. All marine mammals are protected under the MMPA. The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. Travis County is not a coastal county. The action area of the proposed project is not located on the Gulf Coast or within a tidal area; therefore, it is not within range of marine mammals or their habitat. No portion of the proposed project occurs within intertidal or beach areas where marine mammals would be expected to occur; therefore, the provisions of the MMPA would not apply to the OHP Project.

4.1.9 Bald and Golden Eagle Protection Act

Within the U.S. or anywhere within its jurisdiction, Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*) are protected by the Bald and Golden Eagle Protection Act (BGEPA). The BGEPA (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. No suitable nesting or foraging habitat exists within the project area for either of these species. Therefore, no impacts to eagles are anticipated from construction of the proposed project.

4.1.10 Trinity River Corridor Development Certification

The Trinity River Corridor Development Certificate process aims to stabilize flood risk along the Trinity River. The proposed OHP Project is located within Travis County, which is not included within the regulatory limits of the Trinity River Corridor; therefore, this certification is not applicable to the proposed project.

4.1.11 International Boundary and Water Commission

The International Boundary and Water Commission (IBWC) is a federal government agency tasked with applying the boundary and water treaties of the U.S. and Mexico. Travis County is not located within the limits of international waters or boundaries; therefore, coordination with the IBWC would not be required.

4.1.12 Wild and Scenic Rivers

The Wild and Scenic Rivers Act was enacted into law on October 2, 1968. Section 1(b) of the Act states that "certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations (National Park Service, 2013). Wild and Scenic Rivers are managed by an interagency council consisting of the National Park Service, the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS), and the Bureau of Land Management. According to the National Park Service, the only Wild and Scenic River in Texas is the Rio Grande at Big Bend National Park. As there are no Wild and Scenic Rivers in the vicinity of the OHP Project corridor, this Act does not apply to the proposed project. Additionally, there are no river segments in the project area on the Nationwide Rivers Inventory, which is maintained by the National Park Service.

4.1.13 Native American Concerns

The following tribes were contacted during project initiation:

- Alabama-Coushatta Tribe of Texas
- Apache Tribe of Oklahoma
- Caddo Nation of Oklahoma
- Comanche Nation of Oklahoma
- Kiowa Indian Tribe of Oklahoma
- Mescalero Apache Tribe

- Tonkawa Tribe of Indians of Oklahoma
- Wichita and Affiliated Tribes

As potentially interested parties, these tribes were contacted in November 2012 to determine their interest in becoming participating agencies for the OHP Project. The expectations for participating agencies were to respond in writing affirming or declining the invitation. If no response was received from the tribe it was assumed they did not wish to be a participating agency, and no further correspondence regarding the OHP Project was sent.

The role of participating agencies was described as:

- Identify as early as practicable any issue of concern regarding the project's environmental or socioeconomic impacts.
- Identify as early as practicable any issues that could substantially delay or prevent an agency from granting a permit, delay completion of the environmental review process, or result in denial of approval needed for the project.
- Provide input on purpose and need, methodologies, and alternatives within 30 days of receipt thereof.
- Provide input on the project plan and schedule.
- Participate as needed in the issues resolution process.

The Tonkawa Tribe of Indians of Oklahoma declined the invitation to be a participating agency for the project, and no response was received from any of the other tribes contacted. This initial coordination with Native American Tribes is documented in the project's coordination plan (TxDOT, 2013).

4.2 Land Use

This section describes current land use patterns in the project area and the project's potential effect on land uses within the existing transportation corridor. Land uses were identified on parcels adjacent to the proposed right-of-way for the *Build* and *No Build Alternative*s. Direct impacts have been estimated using the proposed right-of-way for each of the respective *Build Alternatives*.

To assess environmental impacts related to land use, information has been collected, such as local and regional land use plans and geographic information system (GIS) database resources, including the 2012 COA Land Use GIS dataset. For this analysis, land uses were organized into 11 dominant land use categories: cemetery, commercial, community facility, education, healthcare, institutional/infrastructure, place of worship, light industrial, multi-family residential, single-family residential, and undeveloped lands. Lands designated as undeveloped indicates that these parcels lack buildings or on-site services; undeveloped properties include a range of COA zoning designations. See **Appendix B**, *Community Impacts Assessment Technical Report* for a detailed summary.

Existing land uses were field verified to confirm they corresponded with COA zoning designations; where appropriate, GIS information was modified based on observed conditions (**Figure 4-1a** through **4-1h**). Site visits and aerial photographs were used to assess land use compatibility and to identify sensitive land uses such as single-family residences and schools. GIS tools were used for the quantitative analysis of direct impacts related to conversion of existing lands to a transportation-related use.

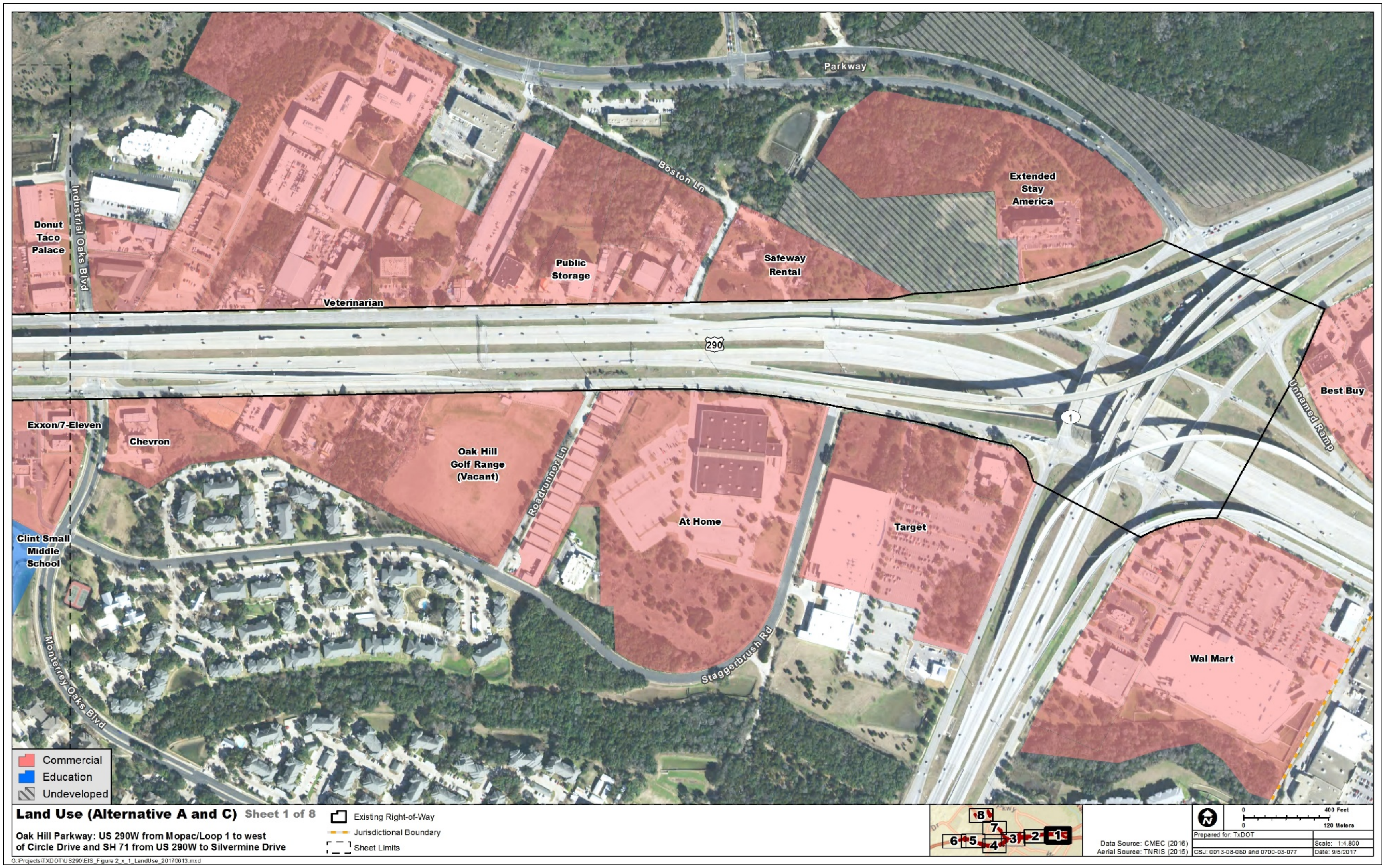

Figure 4-1a. Existing land uses in the OHP Project area.

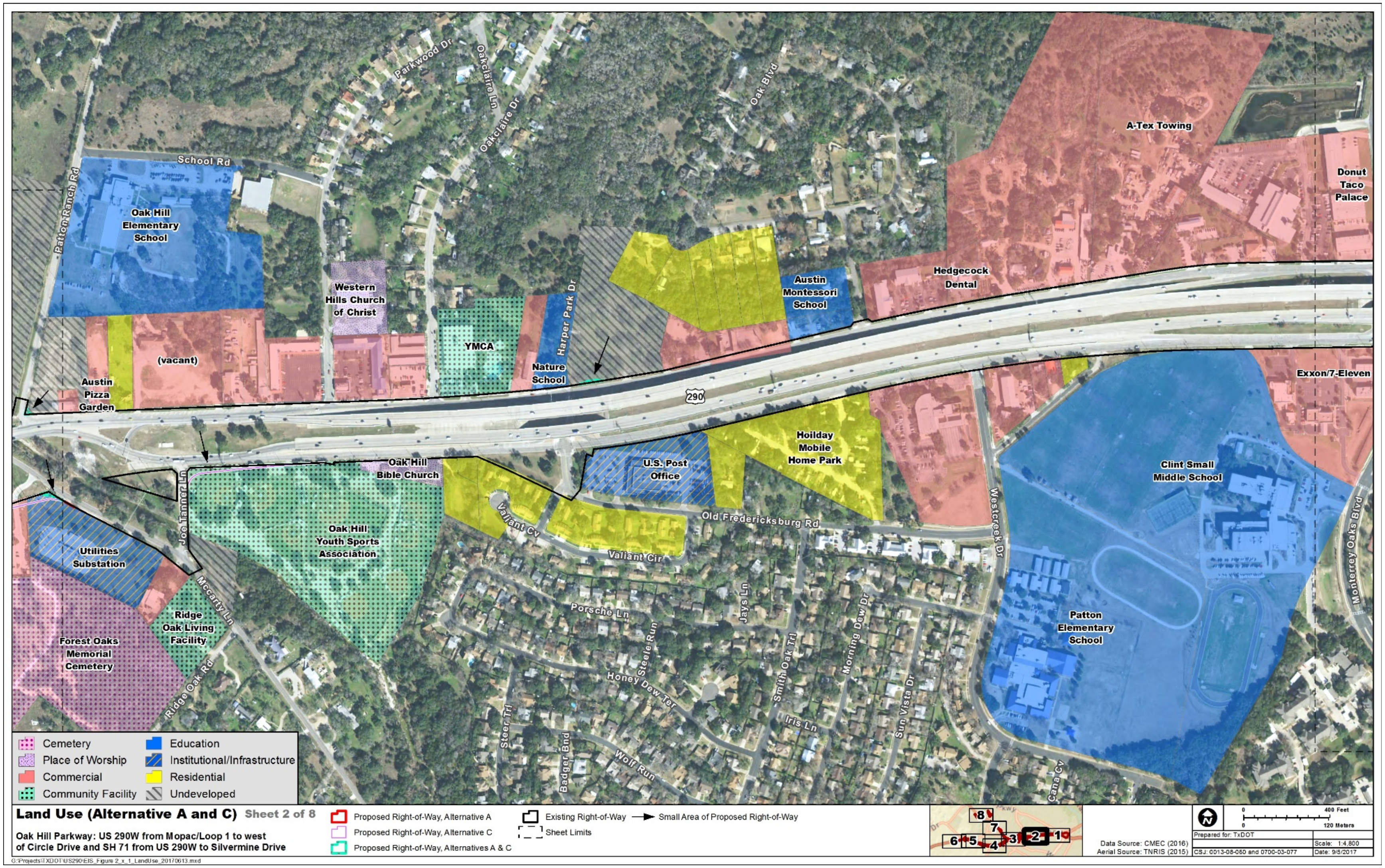

Figure 4-1b. Existing land uses in the OHP Project area.

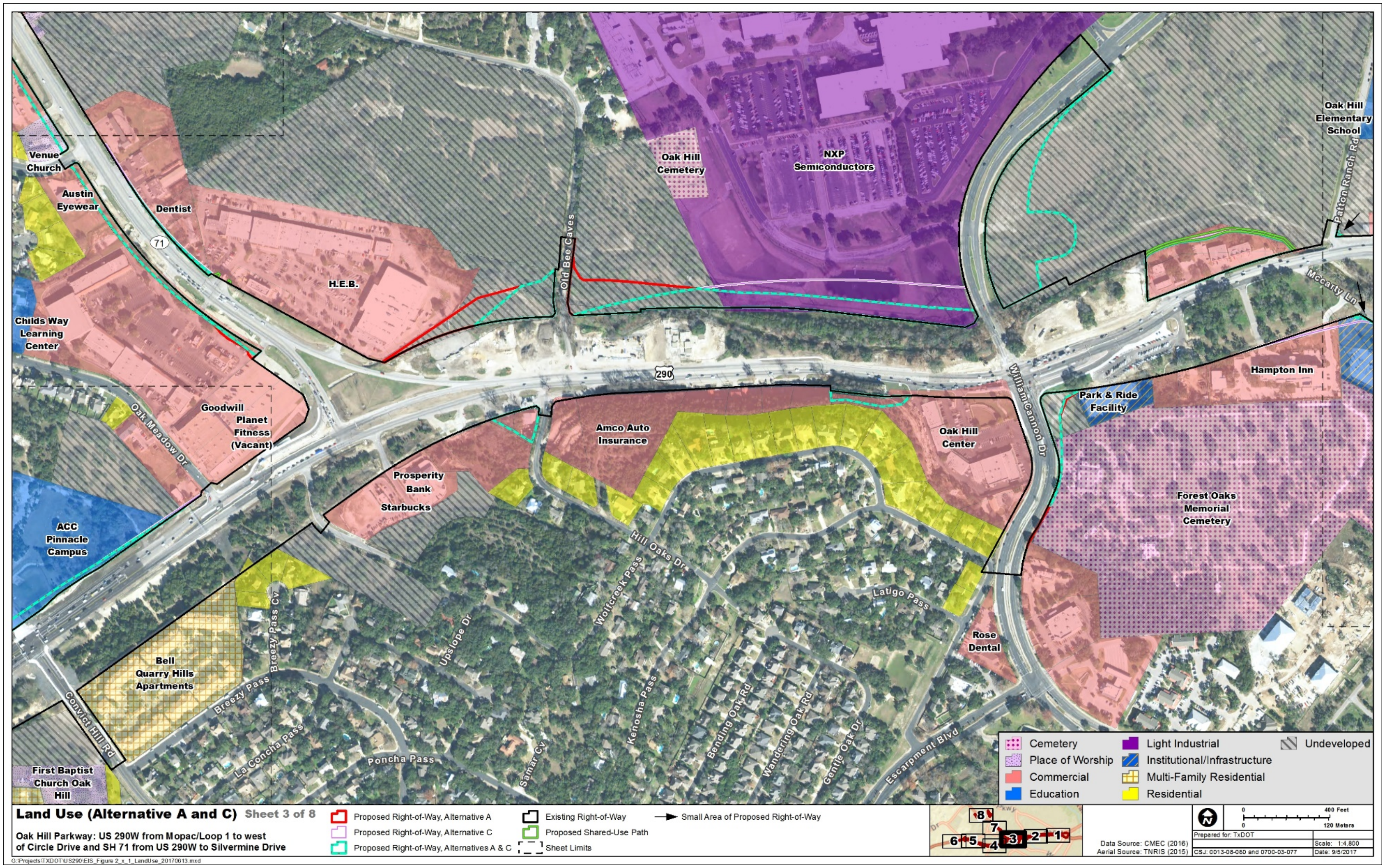

Figure 4-1c. Existing land uses in the OHP Project area.

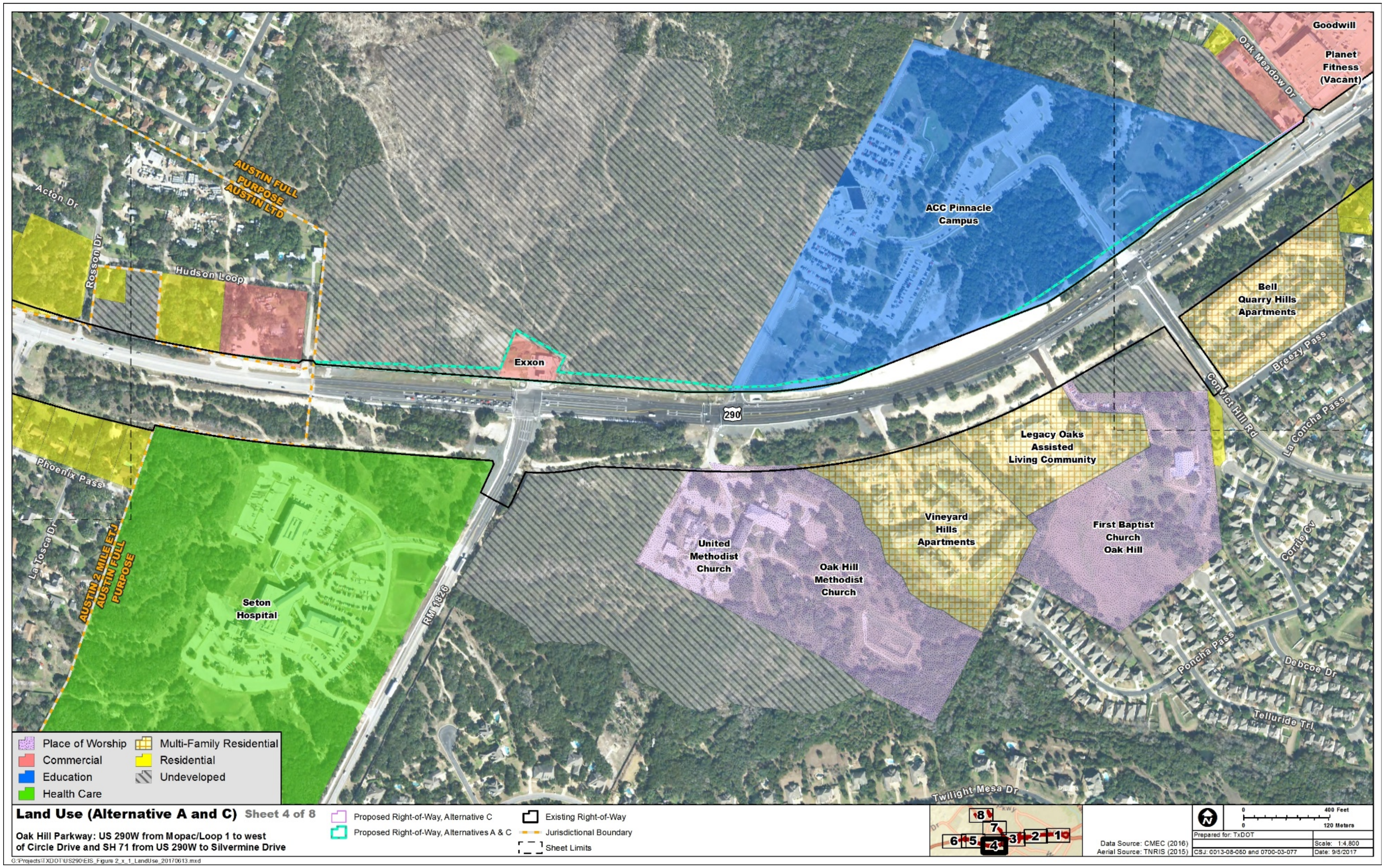

Figure 4-1d. Existing land uses in the OHP Project area.

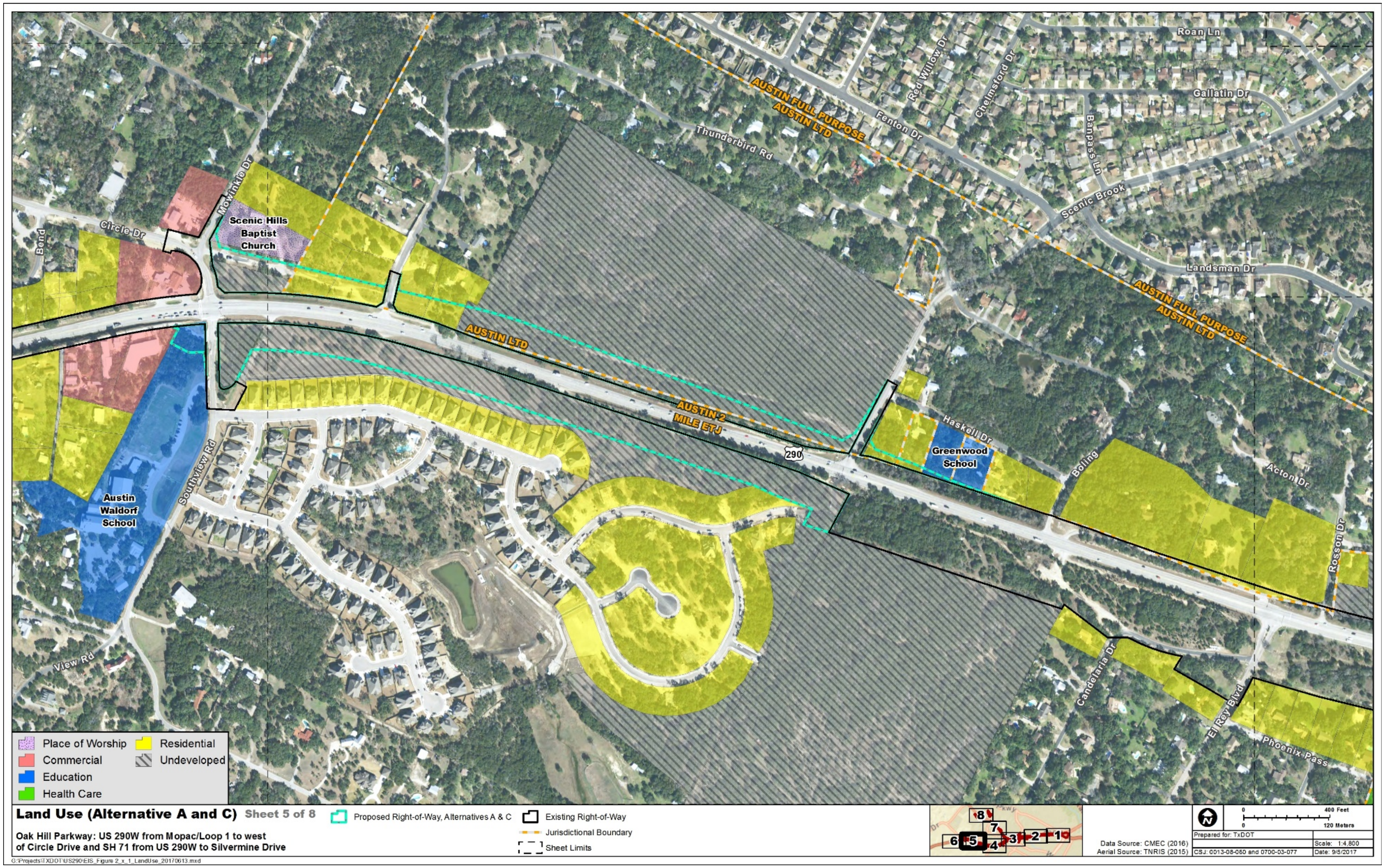

Figure 4-1e. Existing land uses in the OHP Project area.

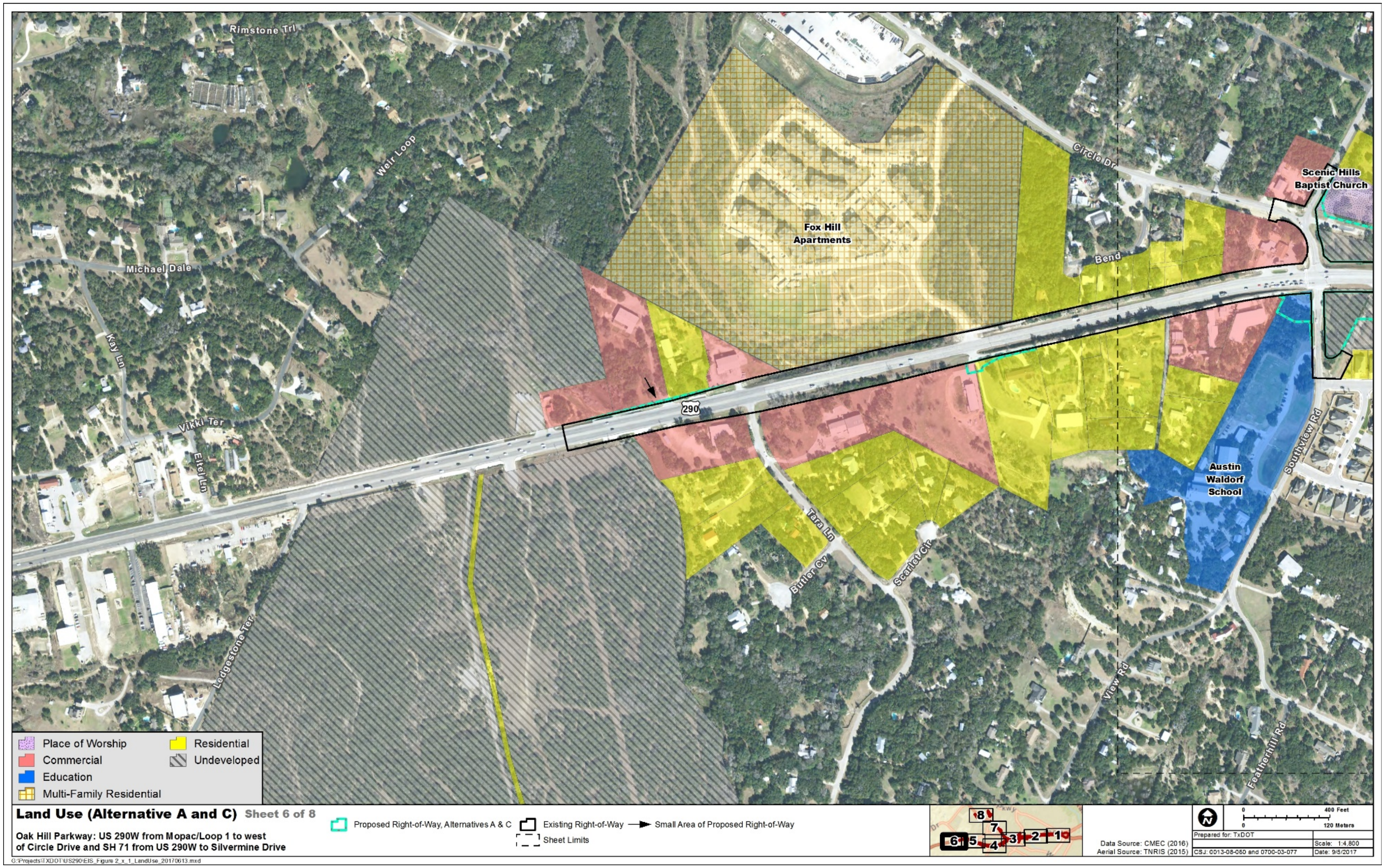

Figure 4-1f. Existing land uses in the OHP Project area.

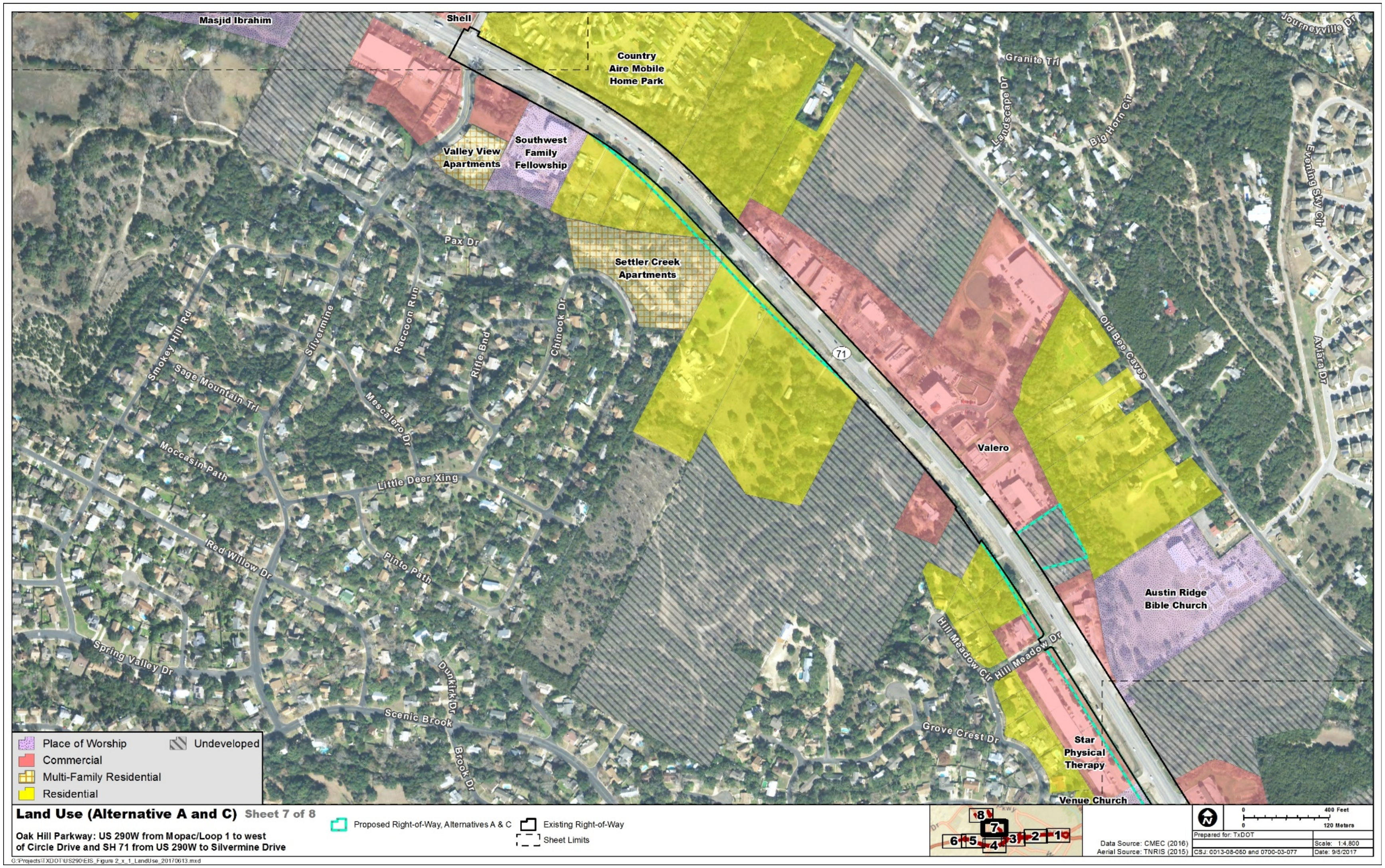

Figure 4-1g. Existing land uses in the OHP Project area.

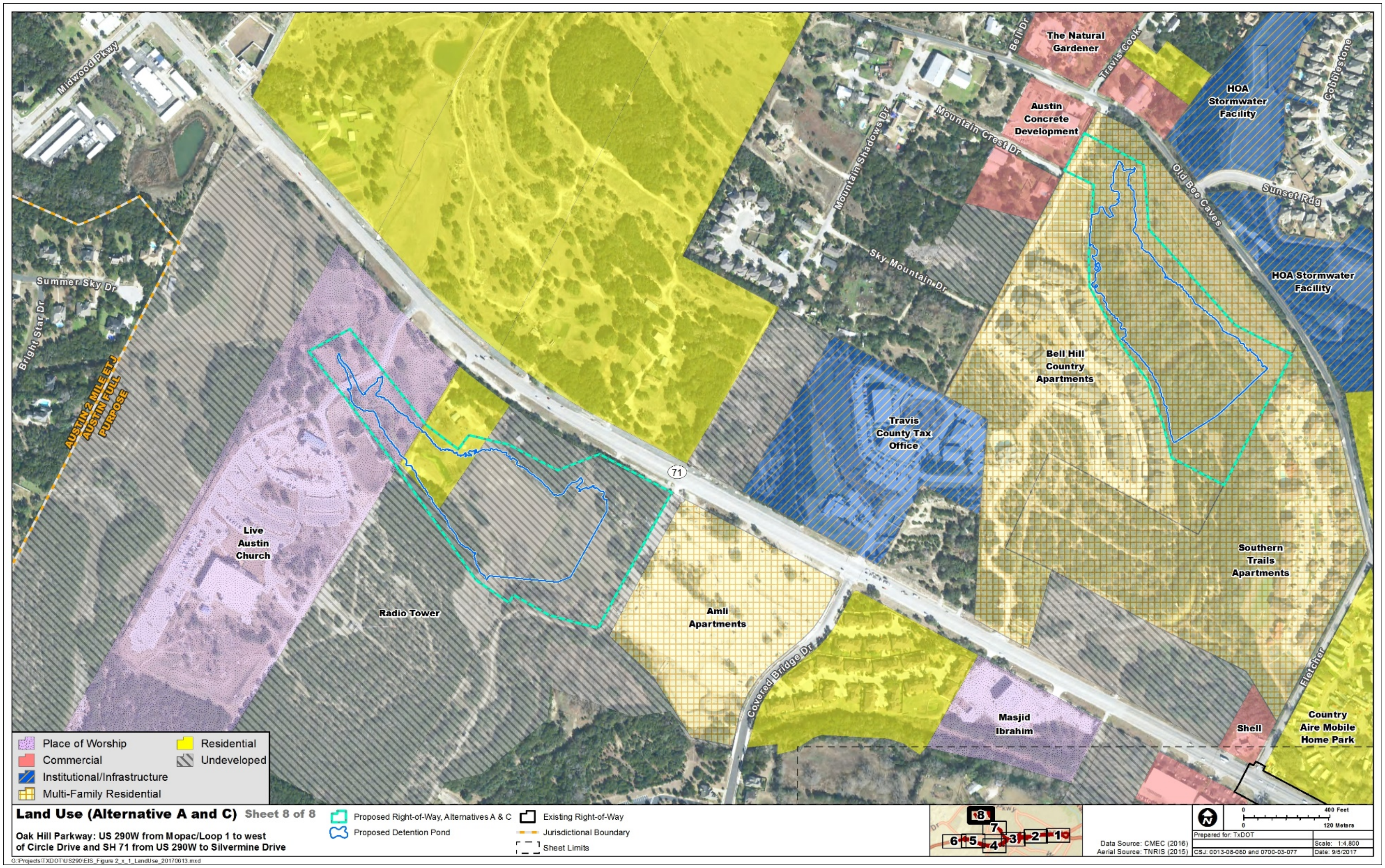

Figure 4-1h. Existing land uses in the OHP Project area.

4.2.1 Consistency with Local Plans and Land Use Policies

Local land use plans and zoning maps were reviewed to determine consistency with plans and policies governing the project area. The COA is in the process of revising its land development code through an initiative called CodeNEXT. As of September 2017, the draft code is still being reviewed by the public; a final version is expected in the spring of 2018. The proposed OHP Project is in the southwest portion of the COA in an area known as Oak Hill. The Oak Hill community was annexed into the COA in 1989. The most pertinent local land use plans and policy documents governing land use in the project corridor are briefly discussed below.

4.2.1.1 CAMPO 2040 Regional Transportation Plan

The CAMPO 2040 RTP is the active long-range plan for the region, identifying highway, arterial, bicycle, pedestrian, and transit improvements. Planning is based on a 25-year population and employment forecast, which projects the region's population would more than double by 2040 (CAMPO 2015). Vehicle travel in the region is also expected to double by 2040, while road capacity is expected to increase by only 15 percent. CAMPO determined that several sections of roadway within the project area are currently among the top 50 most congested roadways in Austin. Discussions on the project's general conformity to the goals and objectives of the CAMPO RTP can be reviewed in **Section 4.3** Transportation System of this DEIS.

4.2.1.2 City of Austin: Imagine Austin

Imagine Austin (COA, 2012), the city's comprehensive plan, provides a vision to guide growth and development within the city's boundaries over the next 30 years. The plan's Growth Concept Map illustrates priority locations for activity centers, corridors, transportation, open space, and resource preservation. The plan calls for new development to be focused in activity centers and corridors, accessible by walking, bicycling, and transit, as well as by car. The area around the US 290/SH 71 junction is the site of the Oak Hill Center, an "Activity Center for Redevelopment in Sensitive Environmental Areas" due to its location over the Contributing Zone of the Edwards Aquifer. *Imagine Austin* notes that redevelopment in these centers would require state-of-the-art and carefully evaluated development practices to improve stormwater retention and the water quality flowing into the aquifer. Activity centers aim to concentrate development in locations to facilitate the use and efficiency of transit service, shorten commutes, and minimize sprawl. According to *Imagine Austin*, activity centers should be a mixture of land uses so jobs and residents are represented.

The purpose and need for this project is to improve mobility and operational efficiency, facilitate long-term congestion management by accommodating movement of people and goods for multiple modes of travel, and improve safety and emergency response times throughout the project area. The proposed transportation project generally supports the *Imagine Austin* plan by developing infrastructure to support land use goals and objectives.

4.2.1.3 City of Austin—Urban Trails Master Plan

Several existing and future planned urban trails are within or close to the project area. These include the recently opened MoPac Mobility Bridges, which provide a bicycle and pedestrian bridge over Loop 360 at MoPac and Barton Creek at MoPac; the "Y" at Oak Hill to Barton Creek Urban (YBC) Trail, which would connect the Oak Hill neighborhood to the Barton Creek area of Austin; and the Violet Crown Trail, a partially constructed 30-mile urban trail. Upon completion, the system would connect the Lady Bird Johnson Wildflower Center in southwest Austin to Zilker Metropolitan Park near downtown Austin. Discussions on the project's general conformity to the goals of the *Urban Trails Master Plan* (COA, 2014) can be reviewed in **Section 4.3** Transportation System of this DEIS.

4.2.1.4 Oak Hill Combined Neighborhood Plan

With some exception of lands along the US 290 corridor between Circle Drive/S. View Road and the westernmost terminus of the project at Ledgestone Terrace, both *Build Alternatives* are located within the Oak Hill Combined Neighborhood planning area. Adopted on December 11, 2008, by the COA City Council, the *Oak Hill Combined Neighborhood Plan* was prepared to support measured, sustainable growth in residential and commercial development while maintaining the existence and integrity of environmental resources, the community, and its neighborhoods.

The project is in general accordance with the *Oak Hill Combined Neighborhood Plan* land use goals, notably when considering the community's goal of creating a mix of uses in existing corridors of commercial development, providing a diversity of local services convenient to neighborhoods, and establishing commercial nodes at strategic locations. By improving mobility and operational efficiency of the roadway, land uses could become more desirable for community investment. The proposed transportation project generally supports the land use goals and objectives of the *Oak Hill Combined Neighborhood Plan* by improving the multimodal travel options to the area, thus providing the infrastructure to support land use goals. From Chapter 6: Land Use and Development:

> The "Y" is where State Highway 71 splits off to the northwest of U.S. Highway 290. There are two aging shopping centers located at this intersection. One, located on the east side of State Highway 71, contains a grocery store as well as several local-serving retail uses such as shops, restaurants, and offices. The other, located on the western side, contains similar uses; however, the grocery store that was once there has closed, leaving a large hole in the shopping center. Throughout the planning process, community stakeholders expressed a desire to see these two shopping centers redevelop as focal points for the community—an Oak Hill Town Center. These centers should become mixed use, pedestrian-friendly destinations accessible by car, bicycle, or foot. The redevelopment should provide places and spaces where people can gather, socialize, dine, shop, and enjoy themselves with family and friends. (COA, 2008:91)

Chapter 6 continues, documenting the stakeholder visioning process for design elements at the Oak Hill Town Center; no consensus was reached through the planning process on design parameters for the Oak Hill Town Center. The stakeholders documented the following on the design of the town center:

> Build a "triangle-style development" with better design elements so it is not walled off from the streets, which give it a fortress-like feeling. (COA, 2008:93)

Under the design parameters of *Alternative A*, at the "Y," US 290 would be in depressed lanes with frontage roads that could be used to develop a grid system to foster mixed use, pedestrian-friendly destinations accessible by car, bicycle, or foot. The design of transportation infrastructure associated with *Alternative A* would generally support the town center design goal of a triangle-style development that is not walled off from streets described in the *Oak Hill Combined Neighborhood Plan*.

Alternative C would require two sides of the "Y" to be developed with both frontage roads and an elevated US 290 mainlane and elevated SH 71 connector road, potentially serving as an impediment to orienting future development to an internal local street system and acting as a visual barrier to the rolling hillsides.

4.2.1.5 Travis County Land, Water, and Transportation Plan

The Travis County Commissioners Court adopted the *Land, Water, and Transportation Plan* on December 2, 2014 to guide population growth and effectively provide county services to keep up with the corresponding demand (Travis County, 2014). Joining with other local elected officials in the region, the county commissioners' and county staff's intent is to minimize conventional urban sprawl. The goals and resulting policies of the plan are intended to encourage more efficient and cost-effective development patterns. The plan emphasizes implementing a similar growth concept to that used in *Imagine Austin* and the CAMPO RTP, focusing future development within activity centers and along transportation corridors.

4.2.2 Existing Conditions

Because the project location begins at the interchange of major transportation corridors and extends into areas historically more rural and agricultural in nature, land uses within the project area corridor vary. In general, higher land use intensity has developed over time on the eastern portion of the project corridor near the US 290/MoPac interchange. Undeveloped and less intensive commercial and residential land uses are more prevalent traveling west along US 290 and north along SH 71. Many of the developed land uses along the project corridor are contemporary large-scale commercial developments interspersed by large paved parking areas. Existing older, small-scale, auto-oriented commercial land uses exist along the south side of US 290 at the base of the bluff just west of William Cannon Drive where SH 71 and US 290 converge, creating an area commonly referred to by locals as the "Y." There is no dominant land use form in the project area; existing patterns of land use adjacent to the project area are typical of a once-rural environment influenced over the years by the introduction and expansion of transportation infrastructure.

4.2.2.1 Existing Conditions at Build and No Build Alternatives

As shown in **Figure 4-1**, land uses adjacent to the existing transportation corridor are predominantly commercial with some residential, undeveloped lands, and institutional uses. Intensity of existing land uses correlates with current capacity and character of the existing transportation corridor, with the highest intensity commercial uses occurring near the easternmost segment of the project adjacent to the US 290/MoPac 1 interchange. Land uses immediately adjacent to the US 290/MoPac interchange are generally large commercial operations with substantial surface parking lots (**Figure 4-1a**). Moving west along the project corridor towards Joe Tanner Lane, the intensity of the commercial land uses decreases and buildings are smaller in scale and operations. Community facilities and educational land uses, along with some residential developments, are present in this segment of the project corridor (**Figure 4-1b**).

A mosaic of land uses exists from west of Joe Tanner Lane to Old Bee Cave Road, where a Capital Metro Oak Hill Park & Ride Facility sits adjacent to the Forest Oaks Memorial Cemetery (**Figure 4-1c**). Other uses include a large light industrial campus (NXP, formerly Freescale Semiconductor), and small-scale commercial operations along the base of the bluff, served by informal surface parking lots. Atop the bluff, overlooking the older commercial district, is an established single-family residential neighborhood, where oak-juniper and native-invasive woodland trees serve as a visual buffer between residents and the project area.

Further west, at the "Y," commercial land uses include a supermarket and national retailer of similar intensity to those at the US 290/MoPac interchange (**Figure 4-1c**). Moving west along US 290, commercial uses are less intense. Some smaller commercial parcels atop the bluff overlooking the project corridor have recently been developed. Traveling west along US 290, large-scale, campus-like institutional and commercial land uses become prevalent, including a community college (ACC-Pinnacle Campus, where operations are contained within a high-rise tower), child education facilities, places of worship, multi-family apartment complexes, and a hospital facility. Large undeveloped vegetated tracts exist in the area along the project corridor, many serving as a buffer between existing uses and the project area (**Figure 4-1c** through **Figure 4-1f**).

Northwest of the "Y," extending along SH 71, there is a patchwork of commercial, multi-family residential, and institutional uses, generally less intensely developed than those along US 290 (**Figure 4-1c** through **Figure 4-1h**). The character of land use in this segment is more rural/suburban, and the density and intensity of land uses are generally aligned with the current carrying capacity of SH 71.

4.2.3 Impacts of Alternatives

Land uses directly impacted by the *Build Alternatives* are those permanently converted to transportation use. Detailed information regarding impacts on existing and proposed land uses, including a summary table of total acres of land uses within the proposed right-of-way of the two *Build Alternatives*, is provided in **Appendix B**: *Community Impacts Assessment*

Technical Report. A summary of impacts to land uses for *Alternatives A* and *C* is provided below in **Table 4-1**.

Table 4-1. Land Use Impacts (Acres) of *Build Alternatives*

Land Use	Impacts of Alternative A: Acres Converted to Transportation Right-of-Way	Impacts of Alternative C: Acres Converted to Transportation Right-of-Way
Cemetery	< 1	< 1
Community Facility	-	< 1
Education	2	2
Health Care	-	-
Institutional/Infrastructure	< 1	< 1
Place of Worship	3.5	3.5
Commercial	6	6
Light Industrial	2	4
Multi-Family Residential	15.5	15.5
Residential	5	5
Undeveloped	41	39
Total	75	75

Source: Project Team, 2017

The total amount of land impacts is similar for both *Build Alternatives*; acreage data was rounded. In considering the total land mass of the project area, the difference in impacts between the two *Build Alternatives* is nominal. For both *Build Alternatives*, out of the 11 aggregated land use categories, 53 percent of all impacts would occur on undeveloped lands (approximately 40 acres). Multi-family residential lands represent the second greatest amount of land use impacts at 20 percent of the total acreage, most of which is from one parcel (**Figure 4-1h**). This multi-family residential land impact would be used to create a stormwater detention pond adjacent to an existing apartment complex (Bell Hill Country Apartments) under both *Build Alternatives*. The remaining land use impacts associated with both *Build Alternatives* are largely partial land acquisitions of front yard setbacks from parcels fronting US 290 and SH 71. These impacts are from a range of land use categories that have developed over time along the transportation corridor. Total land impacts for *Build Alternatives* are negligible in the context of existing land uses and development patterns along the existing transportation corridor.

4.2.3.1 Alternative A

Alternative A requires approximately 75 acres of land be converted to right-of-way, resulting in one residential and four commercial displacements (two of the commercial displacements are to occur due to removal of access). Access to many of the driveways along the corridor would remain or be rebuilt to function similarly to existing conditions; however, 31 driveways would be eliminated and access to 61 driveways would change from having two-way access to/from the roadway to having one-way frontage road access. It is anticipated that land uses remaining on the affected parcels would not be impacted. See **Appendix B**: *Community Impacts Assessment Technical Report* and **Section 4.5.11** for additional details.

Some of the impacts associated with *Alternative A* are for construction of a shared-use path along the length of the project. *Alternative A* would provide improvements to the roadway network and bicycle and pedestrian facilities which would be consistent with the CAMPO 2040 RTP and the 2014 Austin Bicycle Plan by providing a shared-use path along its length.

4.2.3.2 Alternative C

Alternative C requires approximately 75 acres of land be converted to right-of-way along the existing transportation corridor. Displacements would be the same as described above for *Alternative A*. Access to many of the driveways along the corridor would remain or be rebuilt to function similar to existing conditions; however, 36 driveways would be eliminated, and access to 57 driveways would change from having two-way access to/from the roadway to having one-way frontage road access. It is anticipated that land uses remaining on the affected parcels would not be impacted. See **Appendix B**, *Community Impacts Assessment Technical Report* and **Section 4.5.101** for additional details.

4.2.3.3 No Build Alternative

Under the *No Build Alternative*, the proposed project would not be built and changes to existing land uses would not occur. Without the proposed project, the resulting level of service across the transportation system would potentially be lower than planned under the CAMPO 2040 RTP, potentially delaying anticipated development patterns discussed in the *Imagine Austin* and the *Oak Hill Combined Neighborhood Plan*.

Land uses through the proposed project's corridor include educational facilities, recreation, employment nodes, and businesses. Under the *No Build Alternative*, congestion within the corridor would increase and travel times would likely continue to escalate, potentially on access to existing land uses. In addition, anticipated congestion and unreliable travel times through the corridor could make future land use development less desirable.

4.2.3.4 Encroachment-Alteration Impacts

The proposed project is within an existing transportation corridor in an urbanized area of southwest Austin. Properties adjacent to the *Build Alternative* sites may experience direct impacts due to construction and operations on the OHP Project. Private property owners make decisions about developing or redeveloping their property, while cities and counties control land use regulations. Proximate land use impacts could occur if noise, visual, and air impacts were severe enough to contribute to changes to adjacent land uses. Of the identified visual, noise, and air impacts for the *Build Alternatives*, none would be so severe as to alter or negatively affect existing or potential future land uses. These impacts are detailed in the following sections: **4.7 Air Quality**, **4.8 Traffic Noise Analysis**, **4.13 Visual and Aesthetic**

Resources, and **4.17 Construction Impacts**. The potential for induced growth and associated effects is discussed in **Section 5 Indirect Effects**.

4.2.4 Conclusion

Build Alternatives A and *C* would require the acquisition of approximately 75 acres of lands to be converted to transportation right-of-way. Based on the analysis of land use impacts and benefits, the OHP Project would provide overall benefits to the community. Land uses, including commercial activity centers, residential neighborhoods, and community facilities, such as emergency service providers, schools, places of worship, and parklands within the OHP Project corridor would benefit from travel efficiencies resulting from the project. Access to and from some area roadways and neighborhoods onto US 290 and SH 71 would change with implementation of either *Build Alternative* and the function of some driveways would be eliminated or altered (two-way access to the facility changing to one-way access). These changes would occur with either *Build Alternative* and would change traffic patterns in the area.

Residents and travelers through the transportation corridor would maintain access to businesses, community facilities, and other resources, even though traffic patterns would be modified. Overall, congestion would be reduced and mobility and travel times improved such that land use resources would be more easily accessible. The proposed project supports land use goals as articulated by the COA in the *Oak Hill Combined Neighborhood Plan*.

4.3 Transportation System

4.3.1 Description of Existing and Planned System

The existing project corridor serves as a gateway to southwest Travis County and a primary route between central Austin and the communities of Dripping Springs, Bee Cave, Lakeway, and unincorporated areas of Travis and Hays Counties. This section will describe the existing and planned transportation system in the project area, made up of roadway, transit, and bicycle and pedestrian facilities, as well as the impact of the proposed *Build Alternatives* and *No Build Alternative* on the existing and planned system. This section demonstrates that the purpose of the proposed project—improving mobility, promoting long-term congestion management, improving safety, and increasing multimodal travel options—is consistent with transportation policies adopted in the project area.

In addition to TxDOT and the Mobility Authority, several entities conduct transportation planning applicable to the project area, including the COA, Travis and Hays Counties, Capital Metro, and the CAMPO. The following local plans were reviewed for their potential influences on transportation within the study area: the *CAMPO 2040 RTP*; the COA's *Imagine Austin*, *Vision Zero Action Plan*, *Oak Hill Combined Neighborhood Plan*, *Sidewalk Master Plan*, *Urban Trails Master Plan*, and *Bicycle Master Plan*; Capital Metro's *Connections 2025 Transit Plan*; the *Travis County Land, Water, and Transportation Plan*; and the *Hays County Transportation Plan*. **Appendix C: Planning Documents** includes maps of planned roadway, transit, pedestrian, and bicycle facilities that are applicable to the study area. These plans indicate that entities in the study area are anticipating additional growth and are planning for it in terms of multimodal transportation improvements.

4.3.1.1 Roadway

The private automobile is the predominant mode of transportation in the study area. Interim intersection improvements were completed by TxDOT, in cooperation with the COA and Travis County, in 2015 to ease congestion within the project area until a long-term solution could be implemented. CFIs were constructed on US 290/SH 71 at William Cannon Drive and at the US 290/SH 71 junction known as the "Y" (TxDOT, 2015a). CFIs shift left-turning traffic to the outside edges of the road, allowing through-traffic and left-turning traffic to move through the middle of an intersection simultaneously; this increases the number of vehicles that can make it through the intersection in a single traffic light cycle (TxDOT, 2015b). Traditional intersection improvements (dual left-turn lanes) were also constructed in three locations on US 290: RM 1826, the ACC campus, and Convict Hill Road. A center turn lane was constructed on US 290 between RM 1826 and Convict Hill Road (TxDOT, 2015a).

CAMPO coordinates transportation planning in the six-county Austin metropolitan region. The *CAMPO 2040 RTP* is the active long-range plan for the region, identifying highway, arterial, bicycle, pedestrian, and transit improvements. Planning is based on a 25-year population and employment forecast, which projects that the region's population will more than double by 2040 (CAMPO, 2015). The plan notes that the region's most significant mobility challenge is demand on the transportation system from continued rapid growth. CAMPO's primary strategy is to implement projects that represent a strategic allocation of limited resources to address current congestion and safety concerns; these include the proposed project. The OHP Project is identified on the plan's table of fiscally constrained road projects which are expected to be funded between 2015 and 2040. It is described as a six-lane tolled turnpike with frontage roads and is also represented on the map of the proposed 2040 road network as a principal arterial/tolled facility with non-tolled frontage roads (CAMPO, 2015); however, with the potential to proceed with non-tolled mainlanes, TxDOT is currently coordinating with CAMPO to modify their 2040 plan. The relevant pages from the *2040 RTP* are provided in **Appendix C: Planning Documents**; any revisions to the 2040 plan will be included in the FEIS.

Imagine Austin, the COA's comprehensive plan, contains future roadway, bicycle and pedestrian, and transit network maps as part of its Growth Concept Map series (COA, 2012). In the project area, these maps show the proposed alignment of the YBC Trail and Violet Crown Trail, as well as proposed high-capacity bus service. The project corridor is identified as a new highway. As discussed in **Section 4.2 Land Use**, the area around the US 290/SH 71 junction is also the site of an *Imagine Austin* activity center which aims to concentrate development to facilitate the use and efficiency of transit service. The relevant pages from *Imagine Austin* are provided in **Appendix C: Planning Documents**

The COA's *Vision Zero Action Plan* sets forth the goal of reducing traffic crash deaths and serious injuries to zero by 2025, based on a data-driven approach to reducing transportation-related injuries and saving lives (COA, 2016a). Maps used in the plan's analysis show that from 2010 to 2014, road segments within the study area experienced a high number of fatal or incapacitating crashes, particularly at the intersections of US 290 with RM 1826, Convict Hill Road, and SH 71, as well as the intersection of SH 71 and Silvermine Drive. Maps also show that one of the city's seven bicycle deaths from 2010 to 2014 occurred on the project corridor, as well as two of the city's 145 deaths from driving. The plan's recommended actions include directing resources to high injury and fatal crash hotspot locations and working with CAMPO and TxDOT to fund safety improvements (COA, 2016a). The relevant pages from *Vision Zero* are provided in **Appendix C: Planning Documents**.

Funding from the COA's 2016 Mobility Bond is planned to be invested in several projects within the study area, including a corridor improvement project on William Cannon Drive from Southwest Parkway to McKinney Falls Parkway (COA, 2017a). The project may address intersection improvements, sidewalks, bicycle facilities, and transit. The COA describes William Cannon Drive as an "essential activity corridor in South Austin," but notes that in recent years greater development along the corridor has contributed to additional traffic and safety concerns (COA, 2017a). The bond would also fund $8 million toward a regional mobility project in the study area and for the design and replacement of the Old Bee Cave Road Bridge crossing Williamson Creek (COA, 2017b).

The *Travis County Land, Water, and Transportation Plan* emphasizes implementing a similar growth concept to that used in *Imagine Austin*: focusing future development within activity centers and along transportation corridors (Travis County, 2014a). The plan shows SH 71 within the project area as a transportation corridor (Travis County, 2014b, **Appendix C**). The *Hays County Transportation Plan* cites the county's anticipated future growth and its resultant impacts on traffic congestion as contributing to an increased need for new and improved roadway facilities (Hays County, 2013).

4.3.1.2 Transit

Public transportation includes all shared passenger services available to the public. The project corridor is currently served by Capital Metro, which provides urban public transportation services and complementary paratransit services within its service area. Several service routes travel through the corridor, including:

- Route 5—MetroBus local service along US 290/SH 71 to Monterey Oaks Boulevard and Staggerbrush Road to downtown Austin.
- Route 171—MetroExpress or MetroFlyer service along US 290/SH 71 to Scenic Brook Drive and Silvermine Drive. Service goes north on MoPac to downtown Austin.
- Route 970—MetroExpress or MetroFlyer service north of US 290/SH 71 along William Cannon Drive and Southwest Parkway. Service goes north on MoPac to downtown Austin.

- Route 333—MetroBus local service from Travis County Precinct 3 (along SH 71) and the ACC Pinnacle campus south and east along William Cannon Drive to east of IH 35.

The Oak Hill Park & Ride is located within the project area near the southeast corner of US 290/SH 71 and William Cannon Drive. The park and ride facility serves as a commuter hub for Capital Metro, providing service from southwest Austin to central Austin. The Mobility Authority, Capital Metro, and CAMPO are currently developing a park and ride initiative to identify and develop facilities that would provide express service using the Mobility Authority's transportation corridors, one of which is the project corridor (Mobility Authority, 2016). A park and ride near the ACC Pinnacle campus is on the list of potential park and ride projects. Planning, development, and outreach is expected to extend through 2018 (Mobility Authority, 2016).

Capital Metro's *Connections 2025* is a strategic plan that aims to grow ridership and use vehicle and labor resources more efficiently (Capital Metro, 2017a). The *Connections 2025* recommendations for the southwest area include: Constructing a new park and ride facility in Oak Hill (described in the paragraph above), designating the Oak Hill area as a "Mobility Innovation Zone" and replacing existing fixed routes with alternative service pilot projects, and implementing a new route (Route 315) along US 290 between the ACC Pinnacle campus and the South Congress Transit Center to the east (Capital Metro, 2017b; also see **Appendix C** of this document). Potential route changes within the study area include an updated alignment for Route 171, which would serve the new park and ride at the ACC Pinnacle campus and offer express service downtown (contingent upon managed lanes on MoPac). Route 970 would be discontinued due to low performance, and new service from Route 315 would replace routes 333 and 5, which would no longer travel through the study area (Capital Metro, 2017c).

4.3.1.3 Bicycle and Pedestrian Facilities

Bicycle and pedestrian facilities along the existing corridor are intermittent. The interim intersection improvements constructed in 2014 and 2015 included the addition of pedestrian-accessible crossings and bicycle through-lanes to the intersections at US 290 and RM 1826, US 290 and the ACC Pinnacle campus, and US 290 and Convict Hill Road (TxDOT, 2015a). These were also added to the "Y" junction at US 290 and SH 71 and the intersection of US 290 and William Cannon Drive. Planning documents highlight the need for improved bicycle and pedestrian facilities and point toward the planning of multiple urban trails within and around the project area.

Sidewalks are mostly absent from the project corridor. Longer stretches occur on US 290/SH 71 along both sides of the road from west of William Cannon Drive to the Oak Hill Park & Ride, and on both sides of William Cannon Drive south of US 290/SH 71. The *Oak Hill Combined Neighborhood Plan* lists several recommendations that are applicable to pedestrian and bicyclist connectivity in the study area, including: "Provide safe, continuous sidewalks and bicycle lanes separated from vehicular traffic along U.S. Highway 290 to the 'Y'" (COA, 2008:100). The plan notes that community members feel that US 290 and SH 71 prohibit pedestrian, bicycle, and vehicular connectivity in the planning area, and that they would like to be able to safely bike and walk across the roadways.

The COA's *Sidewalk Master Plan* sets a 10-year target of addressing all very high and high priority sidewalks within 0.25 mile of schools, bus stops, and parks (2016b). The plan recommends working proactively with TxDOT and the Mobility Authority to ensure that pedestrian access is provided along all TxDOT and Mobility Authority roadways, including installing sidewalks or shared-use paths and safe pedestrian crossings as part of every improvement project sponsored by these agencies. According to the City's absent sidewalk scoring results as of June 2016, SH 71 from the US 290/SH 71 "Y" junction to Fletcher Drive received a "very high" priority score (COA, 2016b; also see **Appendix C** of this document).

The COA adopted the *Urban Trails Master Plan* in order to create a streamlined and accessible process for the development of urban trails (COA, 2014a). Several existing and future planned urban trails are within or close to the study area (**Appendix C**). These include the recently opened MoPac Mobility Bridges, which provide a bicycle and pedestrian bridge over Loop 360 at MoPac and Barton Creek at MoPac; the YBC Urban Trail which would connect the Oak Hill neighborhood to the Barton Creek area of Austin; and the Violet Crown Trail, a partially constructed 30-mile urban trail which, upon completion, would connect the Lady Bird Johnson Wildflower Center in southwest Austin to Zilker Metropolitan Park near downtown Austin (COA, 2014a).

The YBC Trail was envisioned during the development of the *Oak Hill Combined Neighborhood Plan* in 2008 and later identified by the COA's *Urban Trails Master Plan* in 2014 as a Tier 1 Urban Trail, the highest priority category for trail implementation (COA 2017c). The YBC Trail would run approximately 5 miles and connect the MoPac Mobility Bridges with the ACC Pinnacle campus, major employers AMD and NXP Semiconductors, and other destinations in the area (2017c).

A preliminary engineering report for the YBC Trail was completed in February of 2017, which states that the recommended alignment for the final two trail segments (of four total segments) is to be done in conjunction with the OHP Project (COA, 2017d). The report notes that upon coordination with TxDOT, "it is in the City's best interest to utilize the proposed TxDOT shared-use path from William Cannon and US 290 to the ACC Pinnacle campus as part of the Oak Hill Parkway Project" (COA 2017d:55). Funds for the YBC Trail have been allocated from the COA's 2016 Mobility Bond, and the COA would next proceed into the design phase of the project using the recommended route presented in the preliminary engineering report (see **Appendix C: Planning Documents**).

According to the COA Bicycle Map (COA, 2015), there are several bicycle facilities within the existing project corridor (see **Appendix C: Planning Documents**). These include:

- One extremely low-comfort area was present between Patton Ranch Road and McCarty Lane (crossing US 290/SH 71). These roads are not recommended for bicycle travel, but have no practical alternatives for some trips.
- Several low-comfort roads exist along MoPac and portions of Southwest Parkway and William Cannon Drive. Low-comfort roadway sections serve as important connections but have high traffic volumes and speeds. Little or no bicycle accommodations are provided.
- Medium-comfort roads include Patton Ranch Road, McCarty Lane, Old Bee Cave Road, Convict Hill Drive, Scenic Brook Drive, Thunderbird Road, Silvermine Drive, and Fletcher Drive. Medium-comfort sections include bicycle accommodations on low- to high-speed roads, or shared lanes on roads with low to moderate speeds and volumes.
- One unpaved shared-use hike-and-bike trail was shown on the map connecting Staggerbrush Road to Brush Country Road (part of the COA's Archstone Greenbelt).

The *Austin Bicycle Master Plan* (COA, 2014b) focused on improvements to the bicycle network, including creating an "all ages and abilities" bicycle network. The goal for the all ages and abilities bicycle network is a system that can be enjoyed comfortably and safely by anyone. The proposed network features protected bike lanes, urban trails, and quiet streets, which will be integrated with wayfinding to provide easy connections across the city (COA, 2014b). Project area roadways recommended for inclusion in this network include: Southwest Parkway, William Cannon Drive, Escarpment Boulevard, Industrial Oaks Boulevard, Monterey Oaks Boulevard, Brush Country Road, and McCarty Lane.

The plan states that barriers exist where bike lanes end or geographic barriers prevent connectivity, such as controlled-access highways. US 290/SH 71 between Patton Ranch Road and McCarty Lane is identified as a barrier (this area was also described as "extremely low-comfort" by the city's Bicycle Map). Two other barriers to bicycle riding were identified: along US 290 just west of the "Y," and William Cannon Drive just south of US 290/SH 71. The relevant pages from the *Bicycle Master Plan* are provided in **Appendix C**.

4.3.2 Environmental Consequences

4.3.2.1 Alternatives A and C

Alternatives A and *C* would provide improvements to the roadway network and bicycle and pedestrian facilities consistent with the policies and goals from planning documents discussed in this chapter. Travel conditions along US 290 and SH 71 through the corridor are projected to improve with the selection of a *Build Alternative*. Proposed mainlanes combined with other roadway improvements would alleviate some of the traffic volume along existing frontage roads and make accessing businesses and offices throughout the project corridor easier. Greater access to commuters utilizing other modes of travel, besides a single-occupancy vehicle, would be provided with these alternatives. Both alternatives would be implemented with input from Capital Metro to create appropriate transit options within the corridor.

The Mobility Authority has proposed construction of approximately 7 miles of 10-foot-wide shared-use paths along the OHP Project corridor, from MoPac to Circle Drive along US 290 and from US 290 to Silvermine Drive along SH 71. Improvements are envisioned to connect with the COA's proposed YBC Trail. Striped bicycle lanes on cross streets would be implemented to allow for safe travel across US 290 at Circle Drive, Scenic Brook Drive, Convict Hill Road, William Cannon Drive, and RM 1826. There would be a similar bicycle lane at SH 71 and Scenic Brook Drive. Additionally, the Mobility Authority plans to provide approximately 7 miles of 6-foot-wide continuous sidewalks along the corridor; these sidewalks would be compliant with the requirements of the Americans with Disabilities Act (ADA) (Oak Hill Parkway, 2015).

Under *Alternatives A* and *C*, the Oak Hill Park & Ride would no longer operate or provide service at its existing location at US 290/SH 71 and William Cannon Drive. However, a new park and ride location is currently being identified by the Mobility Authority, Capital Metro, and CAMPO as part of their initiative to develop park and ride facilities providing express service using the Mobility Authority's transportation corridors. Capital Metro has been involved with engaging the public about the proposed project and is actively working to ensure mass transit within the corridor fits the public's needs and helps to foster community cohesion and access within and out of the Oak Hill area.

Access to and from some area roadways and neighborhoods onto US 290 and SH 71 would change with the implementation of a *Build Alternative*, and the function of some driveways would be eliminated or changed (two-way access to the facility changing to one-way access). It is not anticipated that local travel times would increase by more than two to three minutes at certain locations. Overall travel times through the corridor would be anticipated to decrease due to the addition of roadway capacity and reduction of traffic congestion.

The neighborhoods and community facilities within the study area would also experience temporary effects related to construction activities, such as temporary changes in traffic patterns. A traffic control plan would be developed prior to construction to manage and route traffic safely and efficiently, and maintain access to local streets, businesses, and other facilities. The traffic control plan would detail how motorists would be alerted to the time and day of lane closures. Furthermore, construction activities would be scheduled accordingly to minimize traffic disruption within the corridor.

Overall, the proposed project would result in improvements to the existing roadway and transit system and provide improved connections to the bicycle and pedestrian network. *Alternatives A* and *C* would have the same compatibility with the relevant transportation plans mentioned in this section.

4.3.2.2 No Build Alternative

Under the *No Build Alternative*, neighborhoods and community facilities within the study area could be negatively affected over time. As the region continues to grow, more vehicles would be on the roadway, creating increased congestion and reduced mobility for those who live and work within the study area, as well as those commuting through it. Increased congestion along the US 290/SH 71 corridor may encourage drivers to seek alternate routes through neighborhoods using local streets, thereby increasing congestion on local streets. Access to public transit options would remain, but increased congestion could affect the efficiency of service for mass transit.

4.3.2.3 Encroachment-Alteration Effects

The proposed project is located in an existing transportation corridor in an urbanized area of southwest Austin; therefore, adverse encroachment-alteration impacts to the transportation system are not anticipated as a result of the proposed project. To the extent that providing greater bicyclist and pedestrian connectivity is increasingly a priority of transportation agencies, and to the extent that this connectivity is a stronger focus of planning at all levels of government, encroachment-alteration effects on the transportation system through the addition of the planned shared-use path could be beneficial to the transportation corridor. The potential for induced growth and associated affects is discussed in **Section 5 Indirect Effects**.

4.4 Geologic and Soil Resources

The following sections address the physiographic setting, geology, and soils within the study area which is defined as an area within 0.5 mile of the existing right-of-way.

4.4.1 Physiography

The study area is situated at the eastern edge of the Edwards Plateau Ecoregion, just west of the Blackland Prairies Ecoregion (Griffith et al., 2004). The topography in the study area is hilly and highly dissected by the tributaries and main channels of larger creeks. Devils Pen Creek and other tributaries of Slaughter Creek flow through the western portion of the study area. Tributaries of Williamson Creek, including Kincheon Branch, Wheeler Branch, and Motorola Branch, as well as several unnamed tributaries and Williamson Creek proper, dissect the central portion of the study area, and unnamed tributaries of Barton Creek divide the far northeastern portion. Bluffs run parallel to US 290 near its intersection with SH 71.

Elevations in the study area range from approximately 1,050 feet above mean sea level (amsl) in the west to approximately 700 feet amsl in the east. Total topographic relief is approximately 350 feet, and most slopes within this area are in the 5 percent to 10 percent range with steeper slopes up to 15 percent in isolated locales (U.S. Geological Survey [USGS], 1986a, 1986b, 1988a, 1988b).

The climate of Austin is humid subtropical with hot summers and relatively mild winters. The study area receives approximately 33 inches of annual precipitation, with the heaviest amounts normally occurring in May and September (National Weather Service, 2015).

4.4.2 Geology

Geologic formations within the project area include Lower Cretaceous marine deposits and more recent Quaternary sediments. These formations, comprised chiefly of limestone, were deposited on a vast submerged plain known as the Comanche Shelf (Bureau of Economic Geology, 1972). In addition, a portion of the project area lies within the Edwards Aquifer, an environmentally sensitive area. Numerous enhanced karst features occur within the area of the Edwards Aquifer, resulting in a very productive groundwater aquifer (**Figure 4-2**). Karst features are formed from the dissolution of soluble rocks, including limestone, and are characterized by sinkholes, caves, and underground drainage systems. The majority of the recharge into the Edwards Aquifer occurs where surface water flows over faults, fractures, and karst features that have been solutionally enhanced.

The Edwards Aquifer contains several zones, which are based on how water drains in these areas; these include the Recharge Zone, Transition Zone, and Contributing Zone. The Recharge Zone includes an area where highly faulted and fractured Edwards Limestone outcrops occur at the surface, providing a means for large quantities of water to flow into the aquifer with little filtration. The Transition Zone contains areas where limestones that overlie the aquifer are faulted and fractured and include caves and sinkholes. Within this area, it is possible for surface water to flow into the Edwards Aquifer below. The Contributing Zone consists of areas of non-Edwards Aquifer limestones that outcrop at a higher elevation, causing water to drain to stream courses that overlie the Recharge Zone. Additional information regarding the Edwards Aquifer and its zones is provided in **Section 4.9**.

The Texas Speleological Survey database was queried for possible known or existing recharge features within the boundaries of the project area. The Texas Speleological Survey did not include any records for existing recharge features within the project area (Texas Speleological Survey, 2008). Some of the development within the project area predates the era of comprehensive record-keeping of karst features; therefore, it is possible that construction in the vicinity of developed lots might encounter undocumented karst features covered during prior development.

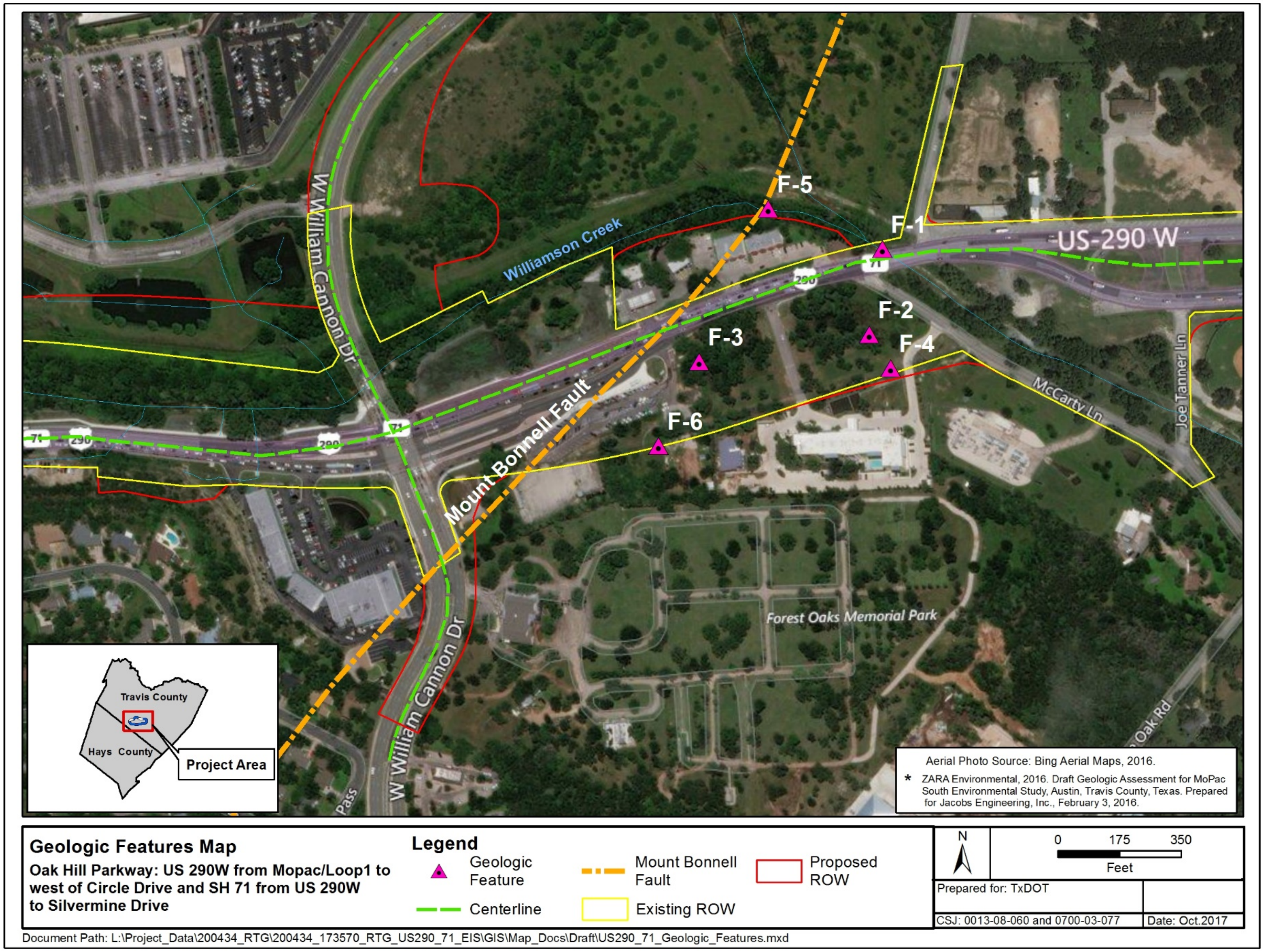

Figure 4-2. Geologic features map.

The Mount Bonnell Fault forms the boundary between the Edwards Aquifer Contributing and Recharge Zones and occurs within the central portion of the project area (see **Figure 4-2**). Fracturing coincident with the fault may provide a pathway for groundwater to enter the limestone and contribution to the formation of caves. The portion of the project area east of the Mount Bonnell Fault is located in the Recharge Zone of the Barton Springs Segment of the Edwards Aquifer (Barton Springs/Edwards Aquifer Conservation District [BSEACD], 2010). Groundwater in this area generally flows from the southwest to the northeast toward a few focused discharge points, and recharge is typically focused at faults and karst features, such as caves and sinkholes. Within the project area, the groundwater hydrology is largely influenced by the karst units of the Edwards Group, which form an outcrop east of the Mount Bonnell Fault. This suggests that the likelihood of karst features occurring within the project area may be greatest east of the Mount Bonnell Fault within the Edwards Aquifer Recharge Zone. In addition, according to communications from the Texas Speleological Survey staff, the distribution of caves on a countywide basis suggests a concentration of caves exists along the east side of the Mount Bonnell Fault.

The geologic units mapped within the Recharge Zone portion of the project area include: Quaternary alluvium (Qal), Quaternary fluviatile terrace deposits (Qhg), the Kainer Formation (Kk) of the Edwards Group and the Upper member of the Glen Rose limestone (Kgru). Geologic units found within the Recharge Zone portion of the project area predominantly include Kk and a smaller area of Qhg along the southeastern border. The remaining portion of the project area lies within the Edwards Aquifer Contributing Zone and contains mainly Kgru areas and moderate portions of Qal located within the north-central portion of the project study area.

Through background research and field investigations, all known karst features in and near the project area were documented during the Geological Assessment (GA) of the project area (**Appendix D**). Six karst features that occur within the existing right-of-way would be affected by project activities; all six features were documented according to Texas Commission for Environmental Quality (TCEQ) guidelines (TCEQ, 2004). Four of these six karst features were scored as sensitive. Gaines Sink (ZARA Environmental, 2016) lies to the east of the project right-of-way and is shown on **Figure 4-3**.

Feature Descriptions:

F1 is a group of widely spaced fractured bedrock within the Williamson Creek stream bed. The fracture apertures are less than one-tenth of one inch wide and do not appear to convey a significant amount of recharge. This feature could be associated with the Mount Bonnell Fault and precautions should be taken to protect flow to this feature during construction activity.

F2 is a solution cavity situated along the base of a bedding outcrop. This feature is infilled by soil and organic debris, and animal burrowing is evident. The potential for rapid infiltration of this feature is low, and it was evaluated as non-sensitive.

F3 is a small outcrop of limestone exhibiting small interconnected solution-enlarged cavities. It was evaluated as non-sensitive with a low relative potential for infiltration.

F4 is a karst zone that encompasses an approximately 100-by-30-foot area on a gently sloping hillside covered with live oak trees and Ashe juniper. Multiple fractures are present within this feature, and apertures appear to show some evidence of solution enlargement, although most are infilled with vegetation and soil. Overall, this feature is expected to have a low potential for recharge to the aquifer due to the large amount of vegetative debris filling the fractures and the Speck soils that occur across this portion of the study area which are characterized by high runoff potential. However, due to the zone classification of this feature and its similarity with the regional structural trend, it was evaluated as sensitive.

F5 is identified as the surface expression of the Mount Bonnell Fault within Williamson Creek which shows little evidence of solution enlargement. Most fractures within the streambed appear to be sealed with fine-grained sediment and vegetative debris. This feature is not exposed in any other location within the project area. It was evaluated as sensitive with a moderate potential for infiltration.

F6 is a solution cavity of about 2 square feet located along the southern limits of the TxDOT right-of-way south of US290. The feature itself appears Y-shaped in plan view and extends to a depth of about 4 feet. Native soils infill the cavity on the sides, and the feature does not appear to open or expand laterally with depth. The feature was evaluated as sensitive with a moderate potential for infiltration.

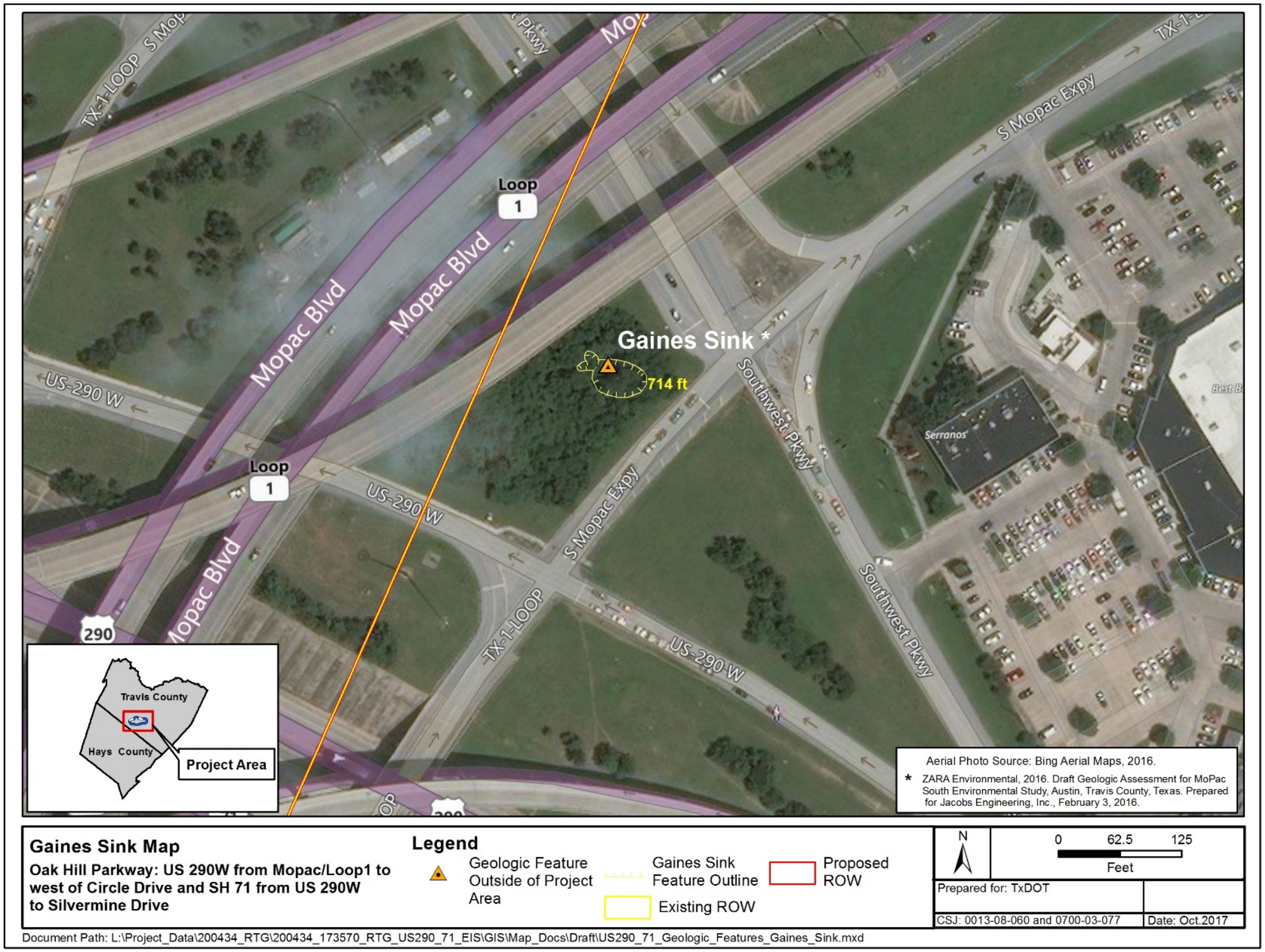

Figure 4-3. Gaines Sink map.

4.4.3 Soils

The project area includes two general soil map units, the Brackett Association and the Speck-Tarrant Association. These soil associations are described as mainly shallow, rolling, and steep soils of the Edwards Plateau (U.S. Department of Agriculture [USDA], 1974). The Brackett Association occurs in the western portion of the project area, beginning near the intersection of US 290 and William Cannon Drive. The Brackett Association primarily includes Brackett and Tarrant soils, with lesser percentages of Volente, Denton, San Saba, Pedernales, and Altoga soils. This general soil map unit includes gently undulating to steep soils capped in some locations on narrow ridges and is well suited for use as rangeland.

The Speck-Tarrant Association includes shallow, stony, loamy soils and very shallow, stony, clayey soils overlying limestone (USDA, 1974). The Speck-Tarrant Association contains two major soil types, Speck soils and Tarrant soils, along with minimal amounts of San Saba soils, Crawford soils, and mixed alluvial land. This soil association occurs east of the Brackett Association soils and is described as nearly level to gently sloping and gently undulating. Areas of this soil association are commonly used for range and are well suited as wildlife habitat.

According to the *Soil Survey of Travis County, Texas* (USDA, 1974) and the USDA Web Soil Service (NRCS, 2015a), twelve soil units occur within 500 feet of the project centerline (on either side of the centerline) or within the proposed detention pond areas (**Figure 4-4**). These soils are described in detail in **Table 4-2** below.

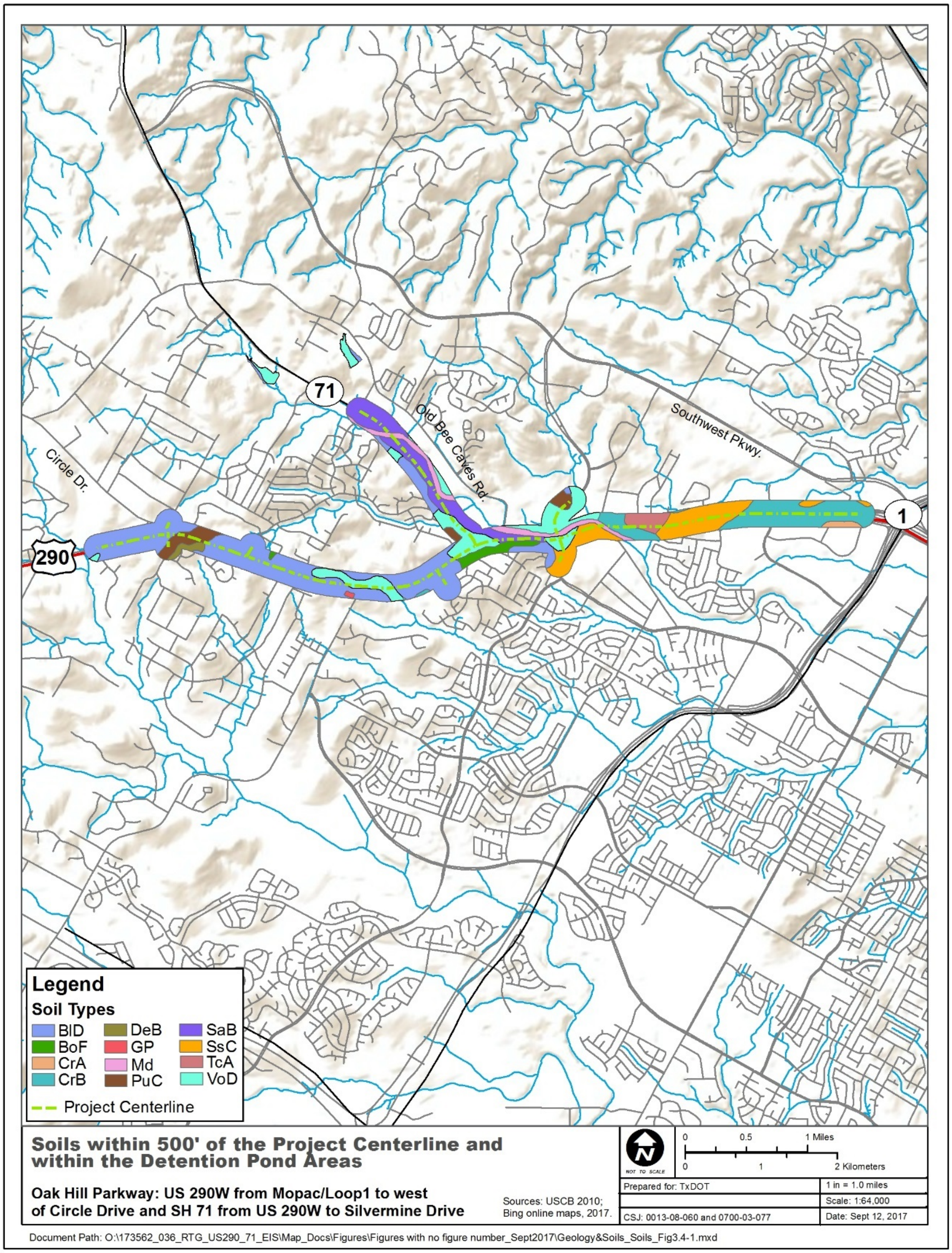

Figure 4-4. Soils within 500 feet of the project centerline and within the detention pond areas.

Table 4-2. Soil Series and Descriptions

Soil Series and Descriptions	Map Unit Name (and ID)	Description of Map Unit	Prime Farmland Soil	Hydric Soil	Acres Within Area	Hydrologic Group*	% of Area
The Brackett soil series consists of shallow, well-drained soils that developed under prairie vegetation of mid-height and tall grasses and trees. Brackett soils mostly have a gravelly surface layer and are underlain by interbedded limestone and marl; some are underlain by fractured chalk. Permeability is moderately slow, and the available water capacity is low.	Brackett-Rock outcrop complex, 1 to 12 percent slopes (B1D)	This complex occupies rolling topography with areas of soil separated by outcrops of limestone and marl. Slopes are typically 5 to 12 percent.	N	N	338.9	D	35.4
	Bracket-Rock outcrop complex, 12 to 60 percent slopes (BoF)	This unit occurs on steep breaks along creeks and rivers with areas of soil separated by outcrops of limestone and marl.	N	N	21.1	D	2.2
Crawford series consists of well-drained, moderately deep, noncalcareous clay soils that developed over hard limestone. These soils are in valleys and on side slopes and ridges, and developed under bunch and short grasses and scattered clumps of trees. These soils crack when dry and are very slowly permeable when wet with a high available water capacity.	Crawford clay, 0 to 1 percent slopes (CrA)	This soil occupies valleys and ridges, mostly in association with more sloping Crawford soils.	Y	N	6.4	D	0.7
	Crawford clay, 1 to 2 percent slopes (CrB)	Slopes on this soil are smooth and this soil seldom gullies. Well suited to range, crops, improved pasture, or hay.	Y	N	129.7	D	13.5
The Denton series consists of moderately deep, well-drained, calcareous clayey soils that developed over interbedded limestone and marly clays. Typically gently sloping and mildly undulating, these soils developed under mid-height and tall grasses. Denton soils are slowly permeable with high available water capacity.	Denton silty clay, 1 to 3 percent slopes (DeB)	This soil occurs on smooth ridges and has a moderate erosion hazard, but is mostly cultivated.	Y	N	8.3	D	0.9
Gravel Pits	Gravel pits, 1 to 90 percent slopes (GP)	Gravel pits.	N	N	1.4	--	0.2

Soil Series and Descriptions	Map Unit Name (and ID)	Description of Map Unit	Prime Farmland Soil	Hydric Soil	Acres Within Area	Hydrologic Group*	% of Area
Mixed alluvial land is a miscellaneous land type that occurs on floodplains of creeks and rivers. It consists of gravelly alluvium, beds of gravel, and exposed limestone beds and boulders randomly interspersed with moderately deep to deep calcareous alluvial materials.	Mixed alluvial land, 0 to 1 percent slopes, frequently flooded (Md)	Mixed alluvial land is found on floodplains. It typically includes very gravelly coarse sand. Well drained, this map unit has very low available water storage.	N	N	41.5	A	4.3
Purves series soils consist of shallow, well-drained soils that developed in interbedded limestone and marl under a cover of mid-height and tall grasses. Purves soils are moderately, slowly permeable and have a low available water capacity.	Purves silty clay, 1 to 5 percent slopes (PuC)	These soils are typically on small knolls where the weathered limestone has been exposed.	N	N	37.3	D	3.9
San Saba series soils include moderately well drained, moderately deep clay soils which overlie limestone. These soils are found in irregular areas on high broad ridges in addition to long, narrow valleys.	San Saba clay, 1 to 2 percent slopes (SaB)	This soil typically occupies smooth, single, and complex slopes on broad uplands and in narrow valleys.	Y	N	99.8	D	10.4
Speck series soils consist of shallow, well-drained soils overlying limestone. Slopes are smooth and complex and are dissected by widely spaced shallow drainageways. These soils developed under a cover of mid-height and tall grasses. Speck soils are slowly permeable, and the water capacity is low.	Speck stony clay loam, 1 to 5 percent slopes (SsC)	This soil occupies smooth, gently undulating topography. Reddish-brown chert pebbles and cobblestones cover up to 50 percent of the surface in most areas.	N	N	108.0	D	11.3
Tarrant series soils consist of shallow to very shallow, well-drained, stony, clayey soils overlying limestone. Large limestone rocks cover 25 to 85 percent of the surface in these soils. They occupy nearly level to gently sloping ridges, rolling side slopes, and steep, hilly breaks. These soils developed under tall grass and an open canopy of trees and are moderately slowly permeable and have low water capacity.	Tarrant and Speck soils, 0 to 2 percent slopes (TcA)	This group occupies long areas on ridges with about 60 percent Tarrant soils, 30 percent Speck soils and small amounts of Crawford soils and rock outcrop. This soil unit is well suited to range use.	N	N	21.6	D	2.3

Soil Series and Descriptions	Map Unit Name (and ID)	Description of Map Unit	Prime Farmland Soil	Hydric Soil	Acres Within Area	Hydrologic Group*	% of Area
The Volente series consists of deep, well-drained soils that developed in slope alluvium under a cover of mid-height and tall grasses and a scattered overstory of trees. Volente soils are moderately slowly permeable, and their water capacity is high.	Volente silty clay loam, 1 to 8 percent slopes (VoD)	This soil series is found on stream terraces. It is well drained with high water storage capabilities.	N	N	144.4	C	15.1
Total					958.6		100.0

Source: USDA, 1974

*Hydrologic Soil Group Definitions: A—Soils having a high infiltration when thoroughly wetted; B—Soils having a moderate infiltration rate when thoroughly wetted; C—Soils having a slow infiltration rate when thoroughly wetted; D—Soils having a very slow infiltration rate when thoroughly wetted.

The USDA has classified soils into one of four groups based on their hydrologic properties: A, B, C, or D. Descriptions of the hydraulic properties for each of these groups were acquired from the USDA publication *Urban Hydrology for Small Watersheds* (USDA, 1986).

- Group A soils have low runoff potential and high infiltration rates when thoroughly saturated. They include deep, well to excessively drained sand or gravel which is usually associated with a high rate of water transmission. Only one Group A soil, mixed alluvial land (Md), was identified within the area analyzed. Md soil primarily occurs along Williamson Creek (**Figure 4-4**) and occupies approximately four percent of the examined soils area.
- Group B soils have moderate infiltration rates when thoroughly wetted and have a moderate rate of water transmission. No group B soils were located within the area analyzed.
- Group C soils have low infiltration rates when thoroughly wetted and consist of moderately fine to fine textured soils which include a layer that can impede the downward movement of water. These are reported to have a low rate of water transmission of 0.05–0.15 inch per hour (USDA, 1986). One Group C soil, Volente Silty Clay Loam (VoD), occurs within the area analyzed, comprising approximately 15 percent of this area (**Figure 4-4**).
- Group D soils have high runoff potential and very low infiltration rates when thoroughly wetted. These soils consist of clay soils with a high swelling potential, high water table, soils with a claypan or clay layer at or near the surface, and shallow soils which occur over nearly impervious material. These soils have a very low rate of water transmission of 0–0.05 in/hr. (USDA, 1986). Group D soils include the 10 remaining soils occurring within the area examined (**Figure 4-4**). Group D soils account for approximately 81 percent of the area analyzed.

4.4.3.1 Prime or Unique Farmland

The Farmland Protection Policy Act (FPPA) was intended to minimize the contribution of federal programs to the unnecessary conversion of prime and important farmlands to non-agricultural uses. Approximately 26 percent of the soils located within 500 feet of the project centerline are designated as prime farmland, and no prime farmland soils were mapped within the detention pond areas (NRCS, 2015a). However, because the proposed project area occurs on land already in urban development it is exempt from the FPPA (Texas GLO, 2015). Coordination with the Natural Resources Conservation Service (NRCS) for FPPA would not be required.

4.4.3.2 Hydric Soils

NRCS guidance was used for the identification of hydric soils within the project study area. The National Technical Committee for Hydric Soils defines hydric soils as those that are sufficiently wet in the upper part to develop anaerobic conditions during the growing season (NRCS, 2015b). No recognized hydric soils are mapped within 500 feet of the project centerline or within the detention pond areas (NRCS, 2015b). However, because soil survey information is not site-specific it does not preclude the need for an on-site investigation for hydric soils (U.S. Army Corps of Engineers [USACE], 2010). A wetland delineation, including a field identification of hydric soils, was conducted for the project and is summarized in Section 4.9.2.3.

4.4.4 Environmental Consequences

The following sections discuss the probable beneficial and adverse environmental effects of *Alternative A*, *Alternative C*, and the *No Build Alternative* on geologic and soil resources. *Alternative A* and *Alternative C* schematics are very similar and impacts would be comparable. The most obvious dissimilarity is that the mainlanes of *Alternative A* are depressed, whereas the mainlanes of *Alternative C* would be elevated. In addition, *Alternative C* would require approximately 0.61 acres more new right-of-way than *Alternative A*.

4.4.4.1 Build Alternatives

Geologic resources within the project area are anticipated to receive minor impacts from *Build Alternative* construction activities. Geologic units located near the ground surface may be exposed, resulting in erosion of those areas. Erosion effects would be minimized by utilizing preventive BMPs including dikes, berms, mulching, erosion control blankets, and other protective measures. Six karst features occur within the existing right-of-way area and would be affected by the *Build Alternatives*. Impacts by the *Build Alternatives* would be largely consistent with the *No Build*, but due to the higher TSS removal, some water quality impacts could be mitigated. Gaines Sink will not be impacted by the *Build Alternatives* as it is outside the construction boundaries of this project. Construction impacts, erosion, and sedimentation issues would be minimized by the use of BMPs both during and after project construction.

Construction activities proposed for the *Build Alternatives* within the project area would result in a range of effects to existing soils. The potential for soil compaction, erosion, or sedimentation would increase along with most construction activities. BMPs, along with other erosion and sediment control measures, would be utilized to minimize erosion and soil loss during these activities. These proposed actions would result in a reduction of project impacts to area soils.

No hydric soils are mapped within 500 feet of the project centerline or within the detention pond areas; therefore, no impacts to this soil type are anticipated to occur.

Although areas designated as prime farmland soils do occur within the project area, the project is within an area of land already in urban development; therefore, it is exempt from the FPPA. No coordination with the NRCS would be required for this project.

Water quality measures, including the use of BMPs during construction and operation of the project, would help reduce and control stormwater runoff within the project area. Structural BMPs would include silt fences, grassy swales, rock filter dams, and water quality ponds.

4.4.4.2 No Build Alternative

The *No Build Alternative* would not require any construction activities that would disturb soils or other geologic resources. Therefore, no erosion or karst feature effects would occur within the project area with the *No Build Alternative*. However, TSS would remain higher than in the *Build Alternatives*.

4.4.4.3 Encroachment-Alteration Effects

Because the project area has been heavily modified by long-term development, encroachment-alteration impacts to geology and soils resulting from the *Build Alternative* would be limited. Erosion and the resulting sedimentation issues would be minimized by the use of BMPs both during and after project construction. The expansion of the existing roadway would alter the existing drainage within the project area, encroaching on the surface or subsurface drainage areas for adjacent sensitive features and altering their hydraulic regime.

4.5 Socioeconomic Resources

Community impacts are discussed in more detail in the *Community Impacts Assessment Technical Report*, included as Appendix B. The report will be updated before publication of the FEIS to reflect TxDOT's and the Mobility Authority's decision to pursue non-tolled mainlanes for this project.

4.5.1 Neighborhoods, Communities, and Mobile Home Parks

The proposed OHP Project area includes portions of many neighborhoods, three public housing communities, and three mobile home parks within 0.5 mile of the corridor's existing right-of-way. A number of the vehicles traveling through the project area would include people who live and work in these locales. Destinations would include commuting to work and/or to access shopping, community facilities, and other services.

4.5.2 Police, Fire, and Emergency Services

Three fire stations, one emergency medical service (EMS) facility, and two medical facilities are located within approximately 0.5 mile of the project area's existing right-of-way. No police stations or substations were located within 0.5 mile of the existing corridor's right-of-way.

4.5.3 Schools

Eight schools are located within approximately 0.5 mile of the project area's existing right-of-way. These include two public elementary schools, one public middle school, one community college, and four private schools.

4.5.4 Places of Worship

Thirteen places of worship are located within approximately 0.5 mile of the project area's existing right-of-way.

4.5.5 Cemeteries

Six known cemeteries are located within approximately 0.5 mile of the project area's existing right-of-way.

4.5.6 Parkland

Sixteen parks, greenbelts, or recreational facilities are located within approximately 0.5 mile of the project area's existing right-of-way.

4.5.7 Other Community Facilities

Five other community facilities are located within 0.5 mile of the existing right-of-way. These include a Capital Metro park and ride facility, a U.S. Post Office, the Southwest Family YMCA, Travis County Community Center at Oak Hill, and the Oak Hill Health Center.

4.5.8 Demographic Characteristics

4.5.8.1 Historic Growth

The Austin area has experienced substantial and sustained growth since the 1990s as shown in **Table 4-3**. Population, number of households, and employment have increased within Austin and the surrounding areas.

Table 4-3. Historic Growth in Population, Households, and Employment

Date Range	Demographic Characteristic	Travis County	Hays County	City of Austin	City of Dripping Springs	City of Sunset Valley
1990–2014	Population	98.1%	181.3%	83.6%	87.2%	140.1%
1990–2014	Households	30.7%	75.8%	27.2%	14.3%	82.2%
1990–2014	Employment	30.8%	62.4%	31.2%	14.0%	94.8%

Sources: Population of Counties by Decennial Census: 1900 to 1990; Texas County populations. Compiled by The County Information Program, Texas Association of Counties; 2010–2014 American Community Survey 5-year, estimates; U.S. Decennial Census 2000, Summary.

4.5.8.2 Race and Ethnicity

The demographic study area (the area within 0.5 mile of the existing right-of-way) contains a population which identifies as predominantly white non-Hispanic or non-Latino (68.5 percent) based on 2014 American Community Survey (ACS) block group data. The remaining nearly 32 percent of the study area population is composed of racial and ethnic minorities including Hispanic or Latino (19.2 percent); Asian (8.6 percent); Black or African American (1.7 percent); and American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and other races or two or more races accounting for approximately 2.1 percent.

The areas of comparison, including Travis and Hays Counties and the cities of Austin, Dripping Springs and Sunset Valley, included more diversity than the study area. The COA (51.3 percent) and Travis County (49.9 percent) had the greatest minority populations followed by Dripping Springs (42.6 percent), Hays County (42.2 percent), Sunset Valley (41.3 percent), and the study area (29.9 percent).

4.5.8.3 Household Income

Household income data are used to understand the economic characteristics of a project area and to identify the presence of low-income populations. According to the U.S. Department of Health and Human Services (HHS) 2017 poverty guidelines, a household is considered low-income if they earn less than $24,600 for a four-person family/household (HHS, 2017).

Income data from the 2010–2014 ACS was used to determine median household income at the block group level, the lowest level for which income information was collected. The ACS measured income over a period of five years (2010–2014) (USCB, 2014c). According to this data set, the median household income in the demographic study area ranged between $57,434 and $171,806, and more than half of the households earned more than $75,000 per year. The study area had a smaller percentage of households that earned less than $25,000 per year than Travis or Hays Counties, Austin, or Dripping Springs (11.0 percent for the study area compared to 20.3 percent, 23.6 percent, 21.8 percent, and 20.8 percent, respectively). The City of Sunset Valley had the smallest share of the population that earned less than $25,000 per year (6 percent). The study area and the City of Sunset Valley had the greatest percentage of households who earn more than $100,000 per year (44.0 percent and 63.5 percent, respectively) compared with Travis County (27.7 percent), Hays County (26.0 percent), Austin (24.9 percent), and Dripping Springs (22.1 percent).

4.5.8.4 Other Demographic Characteristics

The median age of the study area's population was 25 to 29 years old, compared to approximately 20 years old for Austin, 30 to 34 years old for Travis and Hays Counties, 35 to 39 years old for Dripping Springs, and 40 to 44 years old for the City of Sunset Valley. The study area has a slightly higher percentage of residents 65 years of age and older (10.4 percent) compared to Travis and Hays Counties (7.9 and 9.2 percent, respectively). In contrast, Dripping Springs reported 13.7 percent and Sunset Valley reported 13.6 percent of residents as 65 years of age and older. Females comprise approximately 50.7 percent of the study area population, which is slightly higher than the surrounding county and communities (USCB, 2010).

The ACS also collects data on disability at the census tract level. The percentage of people with a disability within the overall study area (7.8 percent) is slightly lower than the percentage found in Travis County or the COA (both 8.8 percent) (USCB, 2010).

4.5.9 Employment and Economic Conditions

4.5.9.1 Employment

There was an approximately 5 percent unemployment rate within the study area, which is lower than the unemployment rate within Travis County, Austin, Hays County, and Dripping Springs (6.8 percent, 6.8 percent, 7.0 percent, and 7.6 percent, respectively) (U.S. Census Bureau [USCB], 2014b), but higher than the rate observed in the small community of Sunset Valley (0.5 percent). Of the labor force that lives within the socioeconomic study area, the largest economic sectors were educational services; health care and social services (21.6 percent); and professional, scientific, management, administrative, and waste management services (18.1 percent). These employment trends were consistent with the dominant economic sectors in Travis County and Austin. In Hays County and Dripping Springs, retail trade and construction were also major economic sectors, along with educational service, health care, and social services.

4.5.9.2 Commercial Activity

The commercial activity along the US 290/SH 71 corridor includes a variety of educational institutions, medical facilities, office complexes, retail shopping centers, supermarkets, restaurants, and hotels.

4.5.10 Displacements and Relocations

Displacements and relocations would be handled according to the Uniform Relocation and Real Property Acquisition Policies Act of 1970, as amended. The potential for displacements and relocations resulting from the proposed alternatives were determined based on schematics provided by the project engineers.

4.5.11 Access Analysis

Currently, mainlanes end near Joe Tanner Lane where they transition to a general four-lane roadway with a center left-turn lane to the west (in areas away from major intersections such as at William Cannon Drive or the “Y’). This configuration provides the opportunity for two-way access from neighborhoods and businesses onto and off of US 290 and SH 71 west of Joe Tanner Lane.

In the existing condition, there were 36 access points which allow direct left-turn access from intersecting roadways onto US 290, and 6 access points providing left-turn access onto SH 71. There are currently 63 direct access points from US 290 onto intersecting roadways, and 12 direct access points from SH 71 onto area roadways. These access points were analyzed to determine where access changes would occur with each alternative. The access points were determined to either have the same access, improved access (areas where access would be provided where there is currently no access onto the facility or where direct connectors or other features would reduce the length travelled to access), or reduced access (areas where a commuter would have to travel a longer distance to access the same point). With proposed improvements, reduced access would occur where an access point is eliminated or where a commuter is no longer able to make a left-hand turn and would have to make a right-hand turn and utilize a Texas Turnaround to reach the same access point. All right turns were determined to be the same as the existing condition.

Currently, access through the corridor is primarily provided by car. Bicycle and pedestrian facilities along the corridor are intermittent. The project corridor is currently served by Capital Metro. Capital Metro provides urban public transportation services and complementary paratransit services within its service area. The service routes travel through the corridor are described in Section 4.3.1.2 above.

4.5.12 Community Cohesion

The proposed OHP Project is in the southwest portion of Austin in the area known as Oak Hill. The existing corridor connects residential communities in southwest Austin, Dripping Springs, the City of Bee Cave, and some unincorporated areas of Travis and Hays Counties with downtown Austin. The corridor contains commercial, suburban residential, and undeveloped land uses. Facilities include fire departments, emergency services, schools, places of worship, cemeteries, and parklands. This is a well-established transportation corridor that defines a boundary for the adjacent neighborhoods.

The project has had extensive public involvement since its inception, with numerous open houses, workshops, and stakeholder meetings. Capital Metro, Austin's public transit provider, as well as Travis County and the COA have all been involved with the proposed project as participating agencies and have received information about the proposed project. Capital Metro has been involved in several of the public involvement events for the proposed project to provide and gather information from the public on how best to provide mass transit within the proposed project corridor.

4.5.13 Environmental Consequences

4.5.13.1 Alternative A

Community Facilities

Table 4-4 summarizes the potential impacts to community facilities including neighborhoods, communities, and mobile home parks; police, fire and EMS services; schools; places of worship; cemeteries; and parklands. After construction, *Alternative A* would be expected to reduce congestion and travel times and improve access, mobility, and reliability within the OHP Project corridor. *Alternative A* would thereby potentially improve access to and reduce travel times to neighborhoods and community facilities in the study area.

Table 4-4. Changes to Community Facilities—*Alternative A*

Category	Impacts
Neighborhoods, Communities, and Mobile Home Parks	8.4 acres would be acquired from the Ridgeview Austin Homeowners Association from two parcels along the south side of US 290 east of Southview Road (Circle Drive). Currently, these parcels are zoned Common Areas and Undeveloped and acquisition would not result in any relocations or displacements. A traffic control plan would be developed prior to construction and construction activities scheduled to minimize disruption. *Alternative A* would not further divide, separate or isolate any neighborhood, community, or mobile home park, and would not affect community cohesion.
Police, Fire, and Emergency Services	No police, fire, or EMS stations or medical service facilities would be directly affected. Temporary changes in traffic patterns during construction may affect emergency responders in the short term. Notification prior to construction and/or temporary roadway closures or detours would be provided to emergency service providers. Following construction, improved access, mobility, and reliability within the corridor would be expected.
Schools	Approximately 1.44 acres of property would be acquired from ACC and approximately 1.37 acres would be acquired from the Austin Waldorf School. No school buildings or facilities would be affected by these acquisitions, as the acquisitions would affect only undeveloped or driveway portions of the properties. Minor and temporary changes to bus routes or school commutes through the study area may occur during construction. Road closures and/or detours would be properly marked.
Places of Worship	*Alternative A* would require the acquisition of approximately 3.98 acres owned by places of worship (0.14 acres from Hill Country Baptist Church, 0.7 acres from Scenic Hills Baptist Church, and 3.14 acres from LifeAustin). These acquisitions would be from portions of the properties that are not currently used for worship or gathering purposes. No buildings at these places of worship would be affected by the acquisitions, and no displacements or changes to the active use of the property would occur.
Cemeteries	Under *Alternative A*, approximately 0.12 acres would be acquired from SCI Funeral Services. The acquired parcels would be slivers along William Cannon Drive and would affect the entrance driveway to the Cook-Walden/Forest Oaks Funeral Home and Memorial Park. The acquisition of right-of-way in this area would not affect the function of the cemetery or funeral home. During construction, access to this cemetery/funeral home may be temporarily affected. However, TxDOT and the Mobility Authority would work with the funeral home to ensure their operations would be ongoing during construction.
Parkland	No parklands would be directly impacted by *Alternative A*. Improved mobility within the corridor would allow for easier access to parklands within the project corridor.
Other Community Facilities	The Oak Hill Park & Ride facility, operated by Capital Metro, would be closed with the implementation of *Alternative A*. Capital Metro may move this facility, but a new location has not yet been identified and it is possible the facility would be closed or unavailable while Capital Metro is assessing options for locations. The remaining other community facilities would continue to operate, and the services they provide would not be adversely affected.

Source: Project Team, 2017

Displacements and Relocations

Eighty parcels, totaling approximately 74.58 acres, would be acquired for *Alternative A*; this would result in one residential and two commercial property displacements due to right-of-way acquisition, and two commercial displacements due to removal of access. The locations of the displacements are shown on **Figure 4-5**. The displacements are described below.

Parcel 14 is an office building at 8556 West US 290, located west of the intersection of Thunderbird Road and US 290. The property currently houses PGH Engineers & Consultants; signs indicating available single and multiple office units for this property were observed on February 15, 2017. PGH Engineers & Consultants provide petroleum and environmental services for the oil and gas industry; they do not provide services for any vulnerable population. The project corridor continues to develop, and many signs indicating office, commercial, and residential spaces for lease were observed within the study area. If the company decided to relocate their offices, or it became necessary, appropriate office space should be available. Several other engineers' offices are located in the project area; however, they likely do not specialize in the petroleum industry. This property owner was contacted by certified letter in April 2017.

Parcel 21e contains the Speedy Stop Food Store (Circle K 3276). Speedy Stop is a gas station and convenience store located on the north side of the intersection of US 290 and RM 1826. It is unknown whether this business could relocate within the project area; however, there were at least six other gas station/convenience stores along US 290 and SH 71 within the proposed project area. The closest gas stations to the Speedy Stop Food Store are approximately 1.4 miles to the west on US 290, approximately 1.3 miles east-northeast on SH 71, and approximately 1.6 miles east on US 290. This store is generally accessed by car and does not serve a specific vulnerable population of people. A certified letter was sent to the owners of this property on February 27, 2017; follow-up email and phone conversations have occurred.

Parcel 76 includes the only impacted residential property, which is located on the west side of SH 71 across from Mountain Shadows Drive. This is a 5.88-acre residential parcel. A search of homes for sale on Zillow.com on February 27, 2017 showed over 30 homes and/or lots for sale within 1 mile of Parcel 76. Housing on these properties would be comparable, but most would be on single-family lots with no additional acreage. The owners of this property have been contacted and met with the project team on April 3, 2017.

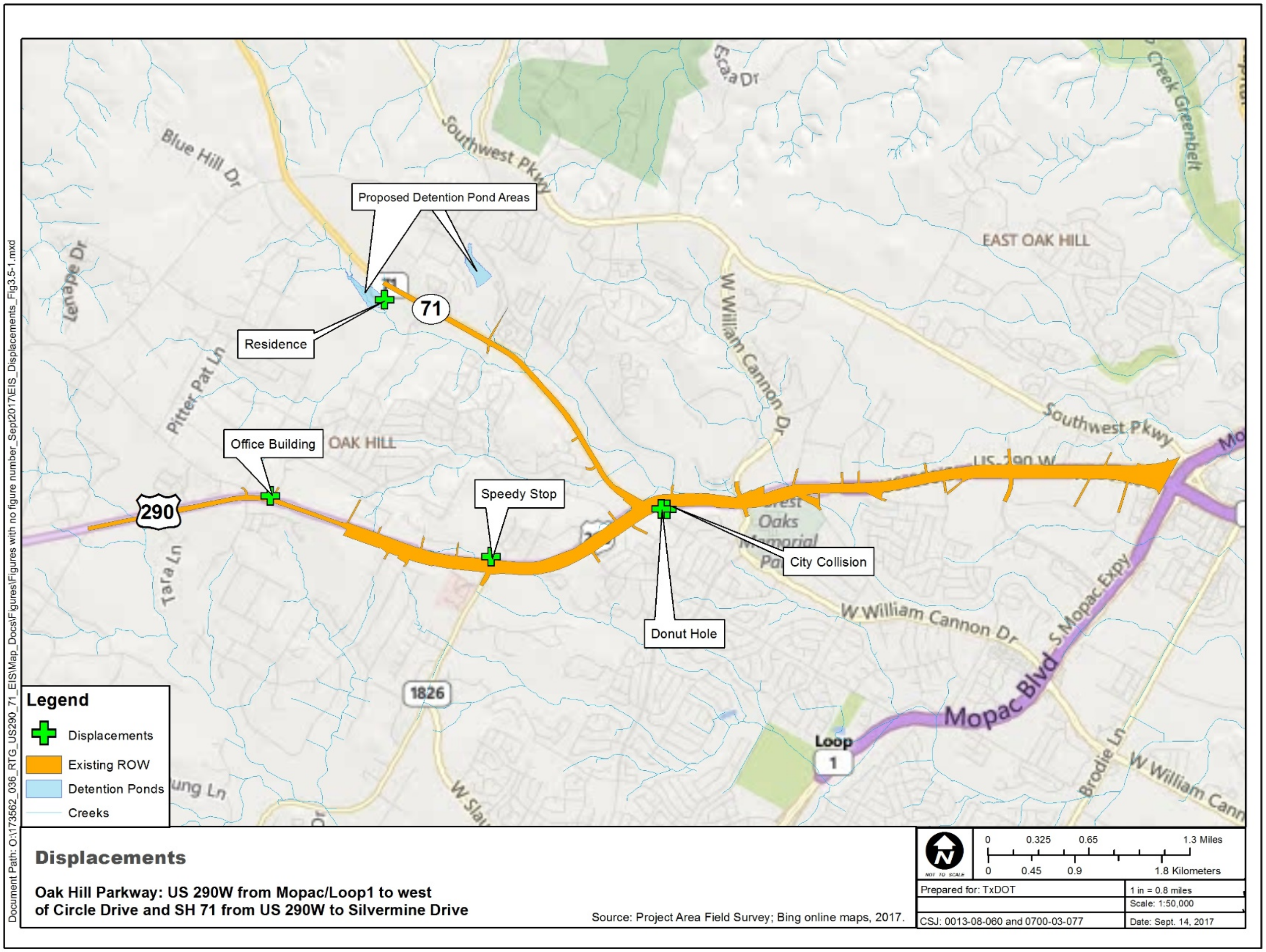

Figure 4-5. Displacements.

The Donut Hole, located at 6863 US 290 West, would be displaced due to loss of access to the property. Two other dessert or donut shops were identified within the study area. Owners of this property were contacted in 2015 and again in 2017 to discuss proposed project impacts.

City Collisions, located at 6861 US 290 West, would be displaced due to loss of access to the property. A search for auto body shops identified three within the study area. The business does not serve a specific population of people, and employment within the industry would be available within the study area. Owners of this property were contacted in 2015 and again in 2017 to discuss proposed project impacts.

These businesses have been contacted consistent with the USDOT policy as mandated by the Uniform Act, which established that all property owners from whom property is needed are entitled to receive just compensation for their land. Just compensation is based on fair market value of the property. The Mobility Authority, in coordination with TxDOT, would provide information and resources to the affected property owners.

Access Analysis

In all, 189 driveways (including both developed and dirt/gravel access) were counted within the study area's existing right-of-way, based on aerial photography. As shown in **Table 4-5**, access to the majority of driveways would remain or be rebuilt to function similar to the existing condition; however, 31 driveways would be eliminated, and access to 61 driveways would change from having two-way access to/from the roadway to having one-way frontage road access.

Table 4-5. Driveway Access Changes—*Alternative A*

	Access to Roadways Remains Similar to Existing Condition	Driveways Eliminated	Access to Roadways Changes from Two Way to One Way
Count	97	31	61
Percent	51.3	16.4	32.3

Source: Project Team, 2017

Land use on the remaining portions of the affected parcels would not be impacted by the proposed project, unless mentioned in the following paragraphs. In addition to changes in driveway access, access to/from US 290/SH 71 from some area neighborhoods and roadways may change.

Several businesses near the "Y" currently utilize TxDOT's existing right-of-way for business activities and parking. These businesses include Tino's Tex-Mex, Kowabunga Coffee, The Donut Hole, City Collision, and Amco Insurance. Under *Alternative A*, it is not anticipated that any new right-of-way would be taken from these parcels. However, due to expected frontage road elevations, access to two parcels would not be maintained and the businesses would be displaced. These parcels include City Collision and The Donut Hole. Access to the remaining businesses would be maintained with *Alternative A*, but the existing TxDOT right-of-way would be required for the project and their business parking areas on TxDOT right-of-way would be reduced.

Table 4-6 summarizes the changes in access that would result under *Alternative A*. As shown in the table, commuters would have reduced access at 21 access points from which they would have to travel a longer distance to reach the same point.

Table 4-6. Access Changes—*Alternative A*

Access Description	Number of Locations Studied	Locations with the Same Access	Locations with Improved Access	Locations with Reduced Access*	Additional Length Required to Access (ft.)
To US 290 from Roadways	36	23	3	9	28,050
From US 290 to Roadways	63	51	3	10	38,950
To SH 71 from Roadways	6	5	0	1	1,800
From SH 71 to Roadways	12	11	0	1	4,600
Total Alternative A	117	90	6	21	73,400

Source: Project Team, 2016
*Reduced access points are those where implementation of the alternative creates a longer travel distance when compared to the existing condition to reach the same point (e.g., instead of making a left-turn onto the facility, a driver would now need to turn right and go through a Texas turnaround). It should be noted that left-hand turns onto the existing facility may be difficult and dangerous due to congestion and/or speed of traffic. Therefore, even though the traffic pattern would change and commuters would no longer have the option for left-hand turns onto the facility at a number of locations, *Alternative A* would include the benefits of enhanced safety and, in some cases, reduced travel time even though a longer distance may have to be travelled to reach a point due to the forced use of a right-hand turn and Texas turnaround. These access changes would not be expected to impact community cohesion, as areas would still be easily accessible and safety would increase. The reduced access changes would require traveling an additional distance ranging between 0.4 mile and 1.25 miles. At most with this alternative, reduced access would result in a commuter having to travel approximately 1.25 miles longer than the current condition. This worst case would be for a traveler on southbound Hudson Loop accessing eastbound US 290; estimated time needed to travel this distance is approximately two to three minutes.

4.5.13.2 Alternative C

Community Facilities

Table 4-7 summarizes impacts to community facilities including neighborhoods, communities, and mobile home parks; police, fire, and EMS services; schools; places of worship; cemeteries; and parklands.

Table 4-7. Changes to Community Facilities—*Alternative C*

Category	Impacts
Neighborhoods, Communities, and Mobile Home Parks	Impacts would be the same as those listed in **Table 4-4** for *Alternative A*.
Police, Fire, and Emergency Services	Impacts would be the same as those listed in **Table 4-4** for *Alternative A*.
Schools	Approximately 1.5 acres of property would be acquired from ACC (0.14 acres zoned Educational, 0.22 acres zoned Parking, and 1.2 acres zoned Undeveloped) and 1.4 acres from the Austin Waldorf School. These acquisitions would be taken from currently undeveloped or driveway portions of the school's property adjacent to US 290; these areas do not serve an educational/recreational purpose for the schools. No school buildings or facilities would be affected by the acquisitions. Minor and temporary changes to bus routes or school commutes through the study area may occur during construction. Road closures and/or detours would be properly marked.
Places of Worship	Impacts would be the same as those listed in **Table 4-4** for *Alternative A*.
Cemeteries	Impacts would be the same as those listed in **Table 4-4** for *Alternative A*.
Parkland	*Alternative C* would require acquisition of 0.2 acres from the Oak Hill Youth Sports Association along US 290 at its intersection with Joe Tanner Lane. This land is zoned as Parks/Greenbelt and is used as a baseball field complex. This sports complex is owned by the Oak Hill Youth Sports Association and is not a publicly owned park or recreation area; therefore, a Section 4(f) evaluation would not be required.
Other Community Facilities	Impacts would be the same as those listed in **Table 4-4** for *Alternative A*.

Source: Project Team, 2017

Displacements and Relocations

Eighty-seven parcels, totaling approximately 75.19 acres, would be acquired for *Alternative C*. The required right-of-way acquisition would result in the same displacements of two commercial properties and one residential property as previously described in *Alternative A* (**Figure 4-5**). Furthermore, as with *Alternative A*, two businesses, the Donut Hole and City Collisions, would also be displaced due to removal of access.

Consistent with the DOT policy as mandated by the Uniform Act, all property owners from whom property is needed are entitled to receive just compensation for their land. Just compensation is based on fair market value of the property. The Mobility Authority in coordination with TxDOT would provide information and resources to the affected property owners.

Access Analysis

In all, 189 driveways (including both developed and dirt/gravel access) were counted within the existing right-of-way within the project area, based on aerial photography. Access to the majority of driveways (50.8 percent) would remain or be rebuilt to function similar to the existing condition; however, 36 driveways (about 19 percent of existing driveways) would be eliminated and access to 57 driveways (just over 30 percent) would change from having two-way access to/from the roadway to having one-way frontage road access (**Table 4-8**). Land use on the remaining portions of the affected parcels is not expected to be impacted by the proposed project. As mentioned under *Alternative A*, changes in access to and from area roadways and neighborhoods onto the facility may also change as discussed in the following paragraphs.

Table 4-8. Driveway Access Changes—*Alternative C*

	Access to Roadways Remains Similar to Existing	Driveways Eliminated*	Access to Roadways Changes from Two Way to One Way
Count	96	36	57
Percent	50.8	19.1	30.2

Source: Project Team, 2016
*With the exception of the driveways discussed in the following paragraphs, where driveways are eliminated, access would be provided in another location or access to the parcel would no longer be required because the parcel would be within existing or proposed right-of-way.

As described above for *Alternative A*, several businesses currently utilize TxDOT's existing right-of-way for business activities and parking. Under *Alternative C*, this right-of-way would be required for the project and impacts would be the same as for *Alternative A*, including the displacement of City Collision and The Donut Hole because access to these properties would not be maintained. Documentation of stakeholder interactions is included in the *Community Impacts Assessment Technical Report*, included as **Appendix B**.

With *Alternative C*, 25 access points would have a longer distance to travel to reach the same point on US 290 and/or SH 71, and 6 locations would have improved access to or from US 290 or SH 71. See **Table 4-9** for a summary of these changes in access.

Table 4-9. Access Changes—*Alternative C*

Access Description	Number of Locations Studied	Locations with the Same Access	Locations with Improved Access	Locations with Reduced Access*	Additional Length Required to Access (ft.)
To US 290 from Roadways	36	23	3	9	31,000
From US 290 to Roadways	63	51	3	10	37.550
To SH 71 from Roadways	6	3	0	3	0
From SH 71 to Roadways	12	9	0	3	7,400
Total Alternative C	117	86	6	25	75,950

Source: Project Team, 2016
*Reduced access points are those where a traveler would need to travel a longer distance with implementation of the alternative then under the existing condition to reach the same point. (As an example,

instead of making a left turn onto the facility, a driver would now need to turn right and go through a Texas turnaround).

4.5.13.3 No Build Alternative

Under the *No Build Alternative*, neighborhoods and community facilities within the study area could be negatively affected over time. As the region continues to grow, more vehicles would be on the roadway, creating increased congestion and reduced mobility for those who live and work within the study area, as well as those commuting through it. Increased congestion along the US 290/SH 71 corridor may encourage drivers to seek alternate routes through neighborhoods using local streets, thereby increasing congestion on local streets.

While routes currently taken by emergency responders would not change with the *No Build Alternative*, in the future, increased congestion may affect travel times for emergency responders or the time it takes for citizens to access medical facilities within the study area.

No new right-of-way would be required, and no schools, places of worship, cemeteries, parkland, greenbelts or recreational facilities, or other community facilities would be directly impacted by the *No Build Alternative*. However, congestion along the corridor would be expected to increase, likely resulting in longer travel times to and from these community resources in and around the study area.

The *No Build Alternative* would not result in any displacements or relocations, changes in access or travel patterns, or changes to community cohesion.

4.5.13.4 Encroachment-Alteration Effects

Besides the closure of the Oak Hill Park & Ride, access to community facilities would not change as a result of the proposed project. Additionally, while right-of-way may be acquired from some community service facilities (such as schools and cemeteries), since the active use of the property would not change, no encroachment-alternation effects would be expected. By improving system connectivity and reducing congestion, it would be anticipated that the *Build Alternatives* would reduce cut-through traffic on neighborhood roadways and provide benefits to emergency responders, Capital Metro, and others traveling through the project area. Construction of a shared-use path and/or sidewalks, as proposed with the *Build Alternatives*, would be expected to provide easier access to nearby parklands and greenbelts. Also, by providing connections to other bicycle and pedestrian facilities in the larger area, the shared-use path and sidewalks would provide improved bicycle connectivity amongst area parks in and outside of the project corridor.

There would be changes in traffic patterns associated with the *Build Alternatives*. In some cases, the use of Texas Turnarounds would be necessary since direct left-turn access onto or off of US 290 or SH 71 would no longer be available. This would not be expected to deter commuters or shoppers from using the facility to access businesses or travel to destinations and would not be expected to otherwise affect community cohesion or neighborhood stability. Encroachment-alteration effects to the area's demographics and community cohesion would not be expected to occur due to the proposed project.

4.6 Environmental Justice

Executive Order 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The FHWA has identified three fundamental principles of environmental justice (EJ) (FHWA, 2015).

The three fundamental principles of EJ are:

- To avoid, minimize or mitigate disproportionately high and adverse human health or environmental effects, including social and economic effects, on minority populations and low-income populations
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority populations and low-income populations

Disproportionately high and adverse human health or environmental effects are defined as adverse effects that

- are predominately borne by a minority population and/or a low-income population; or
- will be suffered by the minority population and/or low-income population and are appreciably more severe or greater in magnitude than the adverse effects that will be suffered by the non-minority population and/or non-low-income populations.

4.6.1 Definitions

Executive Order 12898 and the DOT and FHWA Orders on Environmental Justice address people belonging to any of the following groups (FHWA, 2011):

- Black (having origins from any of the black racial groups of Africa)
- Hispanic/Latino (of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race)
- Asian (having origins from any place of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands)
- American Indian and Alaskan Native (having origins from any of the original people of North America and now maintaining cultural identification through tribal affiliation or community recognition)

- Low-Income (a person whose household income [or in the case of a community or group, whose median household income] is at or below the HHS poverty guidelines [HHS, 2017])

A minority population means any readily identifiable group of minority persons who live in geographic proximity, or, if circumstances warrant, a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), where either type or group experiences common conditions of environmental exposure or effect. Minority populations were identified based on the federal Council on Environmental Quality's (CEQ's) guidance document *Environmental Justice: Guidance Under the National Environmental Policy Act* (CEQ, 1997). Based on this guidance, "Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."

As discussed above, approximately 30 percent of the population in the demographic study area census block groups identified themselves as a minority race or ethnicity. In comparison, 49.5 percent of the population of Travis County identified themselves as a minority race or ethnicity (USCB, 2010). Within the demographic study area, there were 290 populated census blocks in 2010. Of those, 22 blocks had a minority population of 50 percent or greater. These blocks are shown on **Figure 4-6**. See **Appendix B** for the *Community Impacts Assessment Technical Report*. 2010 is the latest date for which information at the census block level is available.

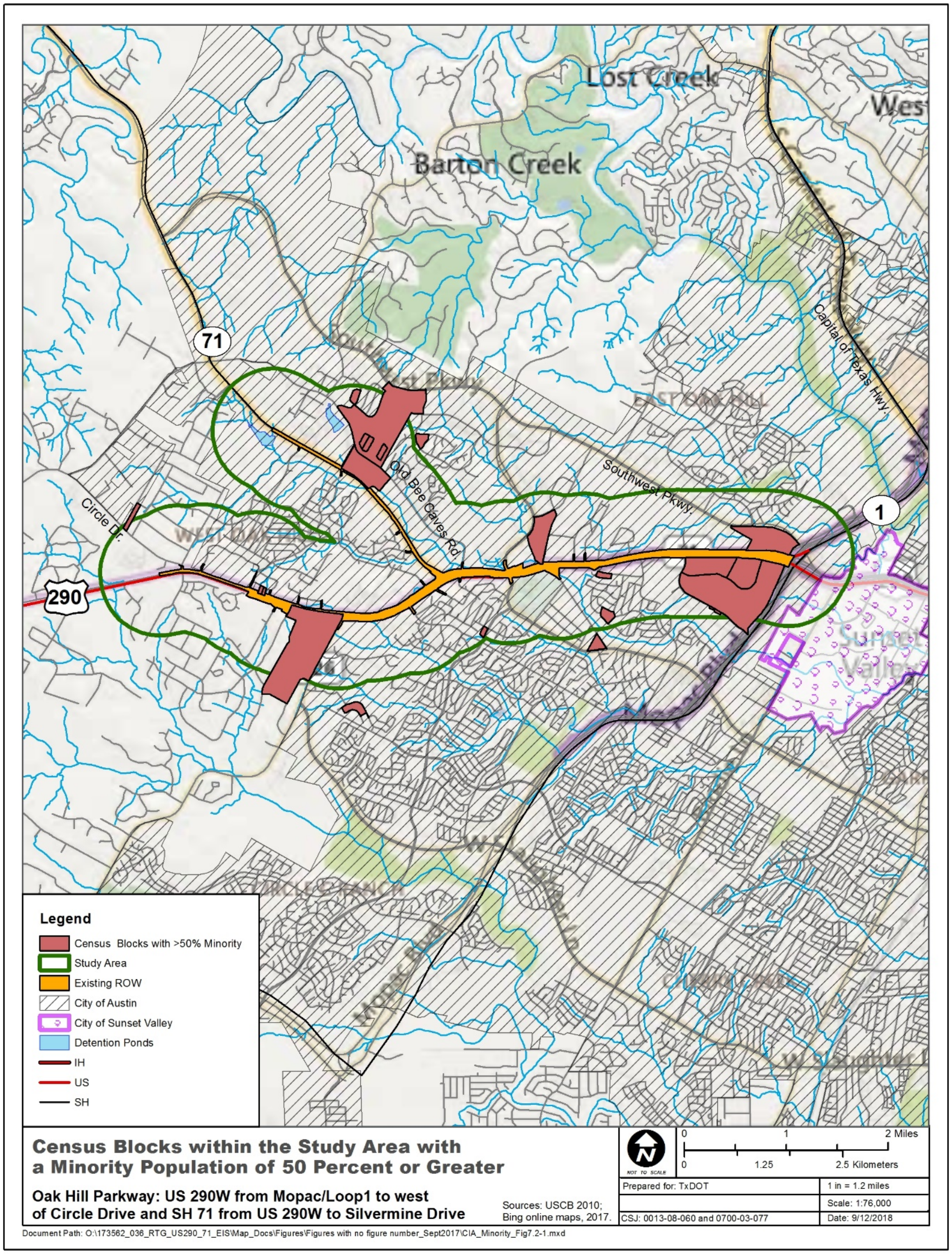

Figure 4-6. Census blocks within the study area with a minority population of fifty percent or greater.

A low-income population is any readily identifiable group of low–income persons who live in geographic proximity, or, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed program, policy, or activity. Unlike the CEQ guidance (1997) on minority populations, no guidance document contains a quantitative definition of how many low-income individuals constitute a low-income population. For this analysis, a block group would be determined to have a low-income population if: (1) there was a meaningfully greater percentage of people in poverty based on the 2017 definition of poverty than the surrounding county area, and/or (2) the median household income of a census block group was below the HHS poverty guidelines. In 2017, the HHS poverty guidelines for a family of four persons is $24,600 (HHS, 2017).

No census block groups in the study area had a median household income below the most recently available poverty guideline. Census tract 17.38, block group 1 and census tract 19.08, block group 2 had 18.5 percent and 18.6 percent of their population below the poverty level, respectively. While these block groups exhibited a slightly higher percentage of the population below the poverty level than Travis or Hays Counties as a whole (17.5 percent and 17.3 percent, respectively), the percentages were not meaningfully greater and were still below the percentages found within the cities of Austin and Dripping Springs. Therefore, no census block groups within the study area were determined to contain a low-income population. See **Appendix B** for the full *Community Impacts Assessment Technical Report*.

4.6.2 Limited English Proficiency

Limited English Proficiency (LEP) is defined as having "limited ability to read, write, speak, or understand English" (67 Federal Register [FR] 41459). Executive Order 13166, "Improving Access to Services for Persons with Limited English Proficiency," requires federal agencies to examine the services they provide, identify any need for services to LEP persons, and develop and implement a plan to provide those services so that LEP persons can have meaningful access to them. Failure to ensure that LEP persons can effectively participate in or benefit from federally assisted programs and activities may violate the prohibition under Title VI of the Civil Rights Restoration Act of 1987.

LEP individuals are defined as those who speak English "well," "not well," or "not at all." Data from the 2010–2014 American Community Survey were gathered at the census block group level to determine if there were LEP populations that could be affected by the OHP Project. As census data is self-reported, an individual's ability to speak English represents the respondent's own perception about his/her ability to speak English. Overall, approximately 6.6 percent of the population in the census block groups within the study area were considered LEP, with Spanish being the most common language after English (USCB, 2014d).

4.6.3 Alternative A

4.6.3.1 Environmental Justice

As shown on **Figure 4-6**, minority populations present within the study area are primarily concentrated around the intersection of US 290 and MoPac, near US 290 and William Cannon, near US 290 and RM 1826, and adjacent to SH 71 and Old Bee Cave Road. No low-income populations were present within the study area. None of the displacements would be located within an EJ area. The proposed improvements would not dissect existing neighborhoods, would generally occur near the existing roadway, and would not be expected to impact community cohesion. The main impacts to minority populations would be anticipated to occur during construction, and would be experienced by all persons (minority and non-minority) in the same way.

Therefore, *Alternative A* would not be expected to result in disproportionately high and/or adverse impacts to EJ populations.

4.6.3.2 Limited English Proficiency

The OHP project team has provided, and will continue to provide, meaningful communications to stakeholders who could be affected by the construction and operations of the OHP Project. Materials were made available in the dominant language spoken (English), and translation services were available for speakers of other languages upon request. The public hearing notices will be published in English and Spanish in *Ahora Sí*. That publication will include a statement saying, “If you require a Spanish translator please contact the TxDOT Point of Contact no later than seven days prior to the public hearing.”

TxDOT and the Mobility Authority have and will continue to conduct public involvement activities for the proposed OHP Project in accordance with Executive Order 13166 to ensure full and fair participation.

4.6.4 Alternative C

4.6.4.1 Environmental Justice

Similar to *Alternative A*, minority populations were present in the project area, but impacts would occur primarily during construction and would be borne equally amongst the population. No low-income populations were present within the study area. Therefore, *Alternative C* would not be expected to result in disproportionately high and/or adverse impacts to EJ populations.

4.6.4.2 Limited English Proficiency

The OHP Project team has provided, and will continue to provide, meaningful communications to stakeholders who could be affected by the construction and operations of the OHP Project. Materials were made available in the dominant language spoken (English), and translation services were available for speakers of other languages upon request.

TxDOT and the Mobility Authority have and will continue to conduct public involvement activities for the proposed OHP Project in accordance with Executive Order 13166 to ensure full and fair participation.

4.6.5 No Build Alternative

With the *No Build Alternative*, the OHP Project would not be constructed and the purpose and need would not be met. Users of the facility would not benefit from improved mobility and operational efficiency, congestion management, or improved safety and emergency response. These impacts would be expected to affect all persons (minority and non-minority and low-income and non-low-income) in the same way. No adverse or disproportionate impact to EJ communities would occur with the *No Build Alternative*.

4.6.6 Encroachment-Alteration Effects

As mentioned previously, minority populations are present within the project area, but no FHWA-defined low-income populations are present. There are, however, low-income individuals residing within the project area. With respect to encroachment-alteration effects, indirect impacts would be driven by changes in travel patterns and access associated with the proposed project. Potential indirect impacts would include improved vehicular access to commercial centers, employment, community centers, and residential areas. Each of the alternatives would result in four commercial and one residential displacement, none of which occur in an FHWA-defined EJ community. Encroachment-alteration impacts due to relocations and displacements would not be expected to occur. There are numerous similar employment opportunities at similar skill levels within the project area, so impacts to employees (such as potential increased commuting time) who could be displaced by the proposed project would be expected to be minor.

Over time, the changes in accessibility and connectivity and the reduction in congestion could cause a change in residential and commercial property values within the project area. With the exception of the Oak Hill Park & Ride, the proposed OHP Project would not be expected to directly impact community facilities, so encroachment-alteration impacts would not be likely to occur. Populations which are dependent upon services provided by these organizations would still be supported, and services provided to EJ communities and individuals would remain intact. Encroachment-alternation impacts to EJ communities would be expected to be minor.

4.7 Air Quality

The Air Quality analysis completed for the project, included in the *Air Quality Impacts Assessment Technical Report* (**Appendix E**), followed the TxDOT *Air Quality Compliance Flowchart for FHWA/FTA and State-only Projects* (TxDOT, 2017). The report will be updated before publication of the FEIS to reflect accurate traffic data following TxDOT's and the Mobility Authority's decision to pursue non-tolled mainlanes.

4.7.1 Conformity to Transportation Plans

The proposed project is located within Travis County, which is designated as attainment or unclassified for all National Ambient Air Quality Standards (NAAQS). Therefore, the project is not subject to transportation conformity.

4.7.2 Carbon Monoxide Traffic Air Quality Analysis (CO TAQA)

AADT volumes for the design year 2040 are estimated to be up to 177,240 vehicles per day (see **Table 4-10**). Since the design-year AADT would exceed 140,000 trips, the need for a Carbon Monoxide Traffic Air Quality Analysis (CO TAQA) is triggered. Traffic volumes used were developed by Rodriguez Transportation Group (RTG) using the TxDOT TP&P Division-approved 2040 CAMPO model.

Table 4-10. 2040 Daily Traffic Volumes

Roadway Link	No Build Alternative	Alternative A	Alternative C
US 290			
West of Circle	41,850	70,320	70,030
Circle to Scenic Brook	43,700	70,000	69,760
Scenic Brook to RM1826	46,145	74,410	74,000
RM 1826 to Convict Hill	45,110	97,800	97,330
Convict Hill to SH71	39,460	96,410	96,850
SH71 to William Cannon	58,270	141,430	140,770
William Canyon to Old Fredericksburg	78,100	152,040	152,390
Old Fredericksburg to Monterey Oaks	80,370	154,860	154,590
Monterey Oaks to MoPac	86,850	156,910	156,510
MoPac to Brodie	91,140	140,800	139,050
East of Brodie	147,670	156,190	156,130
SH 71			
US290 to Scenic Brook	41,750	59,990	62,040
North of Scenic Brook	27,390	44,850	46,680
MoPac			
North of US290	168,490	177,140	177,240

Source: RTG, 2016.

To verify that the proposed project would not result in an exceedance of the 1-hr or 8-hr CO NAAQS, CO TAQA modeling was conducted for the *No Build Alternative*, *Alternative A*, and *Alternative C* for both the opening-year-to-traffic (2024) and design-year (2040) conditions. The CO concentrations were modeled at two different locations to capture the peak traffic volumes in the project area (MoPac/US 290 Interchange) and the largest project-related increase in traffic volumes (SH 71/US 290 Interchange). CO concentrations for the proposed action were modeled using CALINE3 and the TxDOT MOVES2014 emission rate lookup tables and factored in adverse meteorological conditions and sensitive receptors at the right-of-way line in accordance with the *Standard Operating Procedure for Complying with CO TAQA Requirements* (TxDOT, 2015). Local concentrations of CO are not expected to exceed national standards at any time. **Table 4-11** lists the peak 1-hr and 8-hr CO concentrations expected within the project area. As shown, the *No Build* and *Build Alternatives* CO concentrations are far below the NAAQS of 35 parts per million (ppm) and 9 ppm, respectively. The modeling outputs, traffic volumes used in the modeling, and a figure showing the receptor locations are included in Appendix B of the *Air Quality Impacts Assessment Technical Report* (**Appendix E**).

Table 4-11. CO Concentrations (ppm)

Alternative	1-hr	8-hr	Exceed NAAQS?	% of 1-hr NAAQS	% of 8-hr NAAQS
Opening Year (2024)					
No Build	2.0	0.9	No	5.7	10
Alternative A	2.1	0.9	No	6.0	10
Alternative C	2.1	0.9	No	6.0	10
Design Year (2040)					
No Build	1.4	0.5	No	4.0	5.6
Alternative A	1.5	0.6	No	4.3	6.7
Alternative C	1.5	0.6	No	4.3	6.7

Source: Project Team, 2017
Note: CO concentrations include the background concentrations of 1.2 ppm and 0.4 ppm for the 1-hr and 8-hr conditions, respectively.

4.7.3 Mobile Source Air Toxics (MSAT)

As the proposed project would add capacity to the facility and the design-year AADT volumes would exceed 140,000 vehicles per day, it was determined that a quantitative mobile source air toxics (MSAT) analysis would be required for the proposed OHP Project.

4.7.3.1 Project-Specific MSAT Information

For each *Build Alternative*, the amount of MSAT emitted would be proportional to the vehicle miles traveled (VMT), assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for each of the *Build Alternatives* is slightly higher than that for the *No Build Alternative*, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network. This increase in VMT would lead to higher MSAT emissions for the preferred *Build Alternative* along the highway corridor. The reduction in VMT along parallel routes would result in a corresponding decrease in MSAT emissions. The emissions increase is offset by lower MSAT emission rates due to increased speeds; based on the MSAT MOVES2014 emission rates included in the TxDOT Air Quality Toolkit, emissions of all of the priority MSAT decrease as speed increases (U.S. EPA, 2016). Also, regardless of the alternative chosen, emissions would likely be lower than present levels in the design year as a result of the U.S. Environmental Protection Agency's (EPA's) national control programs that are projected to reduce annual MSAT emissions by over 90 percent between 2010 and 2050 (FHWA, 2016). Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

The additional travel lanes contemplated as part of the project alternatives would have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under each alternative there may be localized areas where ambient concentrations of MSAT could be higher under certain *Build Alternatives* than under the *No Build Alternative*. The localized increases in MSAT concentrations would likely be most pronounced along the expanded roadway sections that would be built along OHP.

However, the magnitude and the duration of these potential increases compared to the *No Build Alternative* cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSAT health impacts. In sum, when a highway is widened, the localized level of MSAT emissions for the *Build Alternative* could be higher relative to the *No Build Alternative*, but this could be offset due to increases in speeds and reductions in congestion (which are associated with lower MSAT emissions). Also, MSAT would be lower in other locations when traffic shifts away from them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, would over time cause substantial reductions that, in almost all cases, would cause region-wide MSAT levels to be significantly lower than today.

4.7.3.2 Quantitative MSAT Analysis Methodology

The analysis of MSATs within the project study area considers the on-road sources for the nine priority MSATs: 1,3-butadiene, acetaldehyde, acrolein, benzene, diesel PM, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter. This analysis is based on the approved CAMPO models for each of the analyzed years of 2015 and 2040. These models take into account all future projects expected to be completed by each year, as well as projected traffic for the *Build Alternatives*. For the *No Build Alternative*, the proposed project was removed from the model to generate new projected traffic volumes. An affected transportation network was derived for each *Build Alternative* for the design year 2040 by comparing the *No Build* to *Build Alternative* road link ADTs to determine which roadway links in the model achieve a ±5 percent volume change due to the *Build Alternatives*. The same roadway links identified through this process were used as the affected network links for the base year of 2015 and design year of 2040. VMT was calculated by using the affected network links and the AADTs of those links for each modeled year. Speeds were modeled as average speeds for each link and type of roadway. The analysis used the TxDOT MOVES2014 emission rate lookup tables for each of the priority MSATs.

4.7.3.3 Quantitative MSAT Analysis Results

The resulting emission inventory compiled for the seven priority MSATs for the proposed project is summarized in **Table 4-12** and shown in **Figure 4-7** for *Alternative A* and in **Table 4-13** and **Figure 4-8** for *Alternative C*. The analysis indicates that a decrease in MSAT emissions can be expected for both the *Build* and *No Build Alternative*s in 2040 when compared with the existing year of 2015. Under *Build Alternatives A* and *C*, emissions of total MSAT are predicted to decrease by 70 percent from 2015 to 2040. This general trend is prevalent when comparing the annual emissions of the specific priority MSATs in both the *Build* and *No Build Alternatives* in 2040 when compared with the existing year of 2015. In addition, although the *Build Alternatives* would increase the VMT by more than 150,000, when compared to the 2040 No Build conditions, the total MSAT emissions decrease by 13 percent. If emissions are plotted over time, a decreasing level of MSAT emissions can be seen from the base year (2015), although overall VMT continues to rise.

Table 4-12. MSAT Emissions—*Alternative A* (tons/year)

Toxin	2015 Baseline	2040 No Build	2040 Build	Change from 2015 Baseline	Change from 2040 No Build
Benzene	3.09	1.03	0.93	-2.16	-0.10
Napthalene	0.48	0.26	0.24	-0.24	-0.02
Butadiene	0.41	0.01	0.01	-0.40	0.00
Formaldehyde	4.22	3.26	3.03	-1.19	-0.24
Acrolein	0.29	0.15	0.14	-0.15	-0.01
DPM	25.94	6.35	5.14	-20.81	-1.21
POM	0.19	0.05	0.05	-0.15	0.00
Acetaldehyde	2.08	1.06	0.98	-1.09	-0.08
Ethylbenzene	1.52	0.86	0.77	-0.75	-0.09
Total MSAT	**38.23**	**13.03**	**11.28**	**-26.94**	**-1.75**
Affected Network Daily VMT	2,607,602	6,448,070	6,604,710	3,997,108	156,640

Source: Project Team, 2017

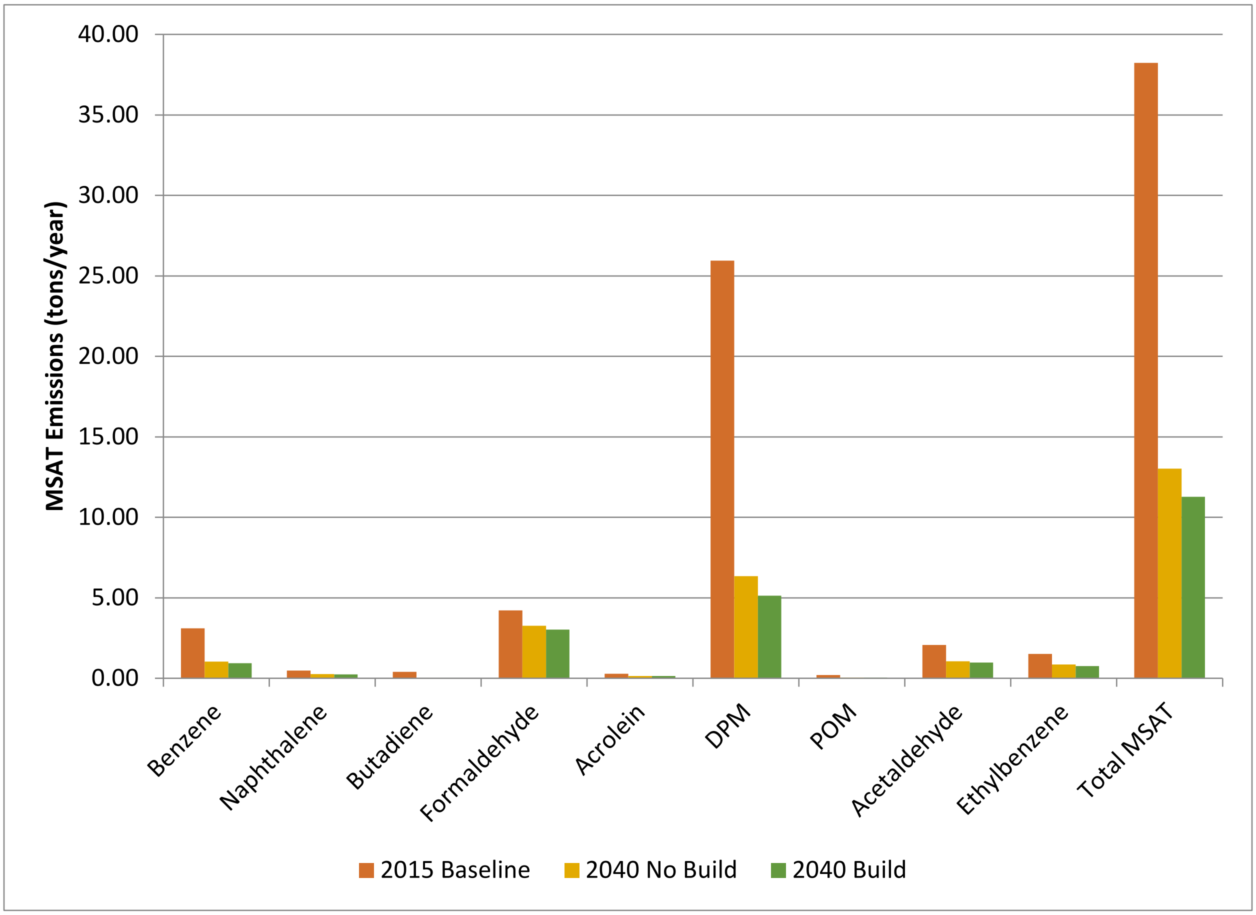

Figure 4-7. Projected changes in MSAT Emissions over time—*Alternative A*.

Table 4-13. MSAT Emissions—*Alternative C* (tons/year)

Toxin	2015 Baseline	2040 No Build	2040 Build	Change from 2015 Baseline	Change from 2040 No Build
Benzene	3.05	1.03	0.93	-2.11	-0.10
Napthalene	0.47	0.26	0.24	-0.23	-0.02
Butadiene	0.40	0.01	0.01	-0.39	0.00
Formaldehyde	4.15	3.27	3.03	-1.12	-0.24
Acrolein	0.28	0.15	0.14	-0.14	-0.01
DPM	25.53	6.36	5.15	-20.39	-1.21
POM	0.19	0.05	0.05	-0.14	0.00
Acetaldehyde	2.04	1.07	0.98	-1.06	-0.08
Ethylbenzene	1.50	0.86	0.77	-0.73	-0.09
Total MSAT	37.62	13.06	11.30	-26.32	-1.76
Affected Network Daily VMT	2,566,189	6,462,235	6,614,696	4,048,507	152,461

Source: Project Team, 2017

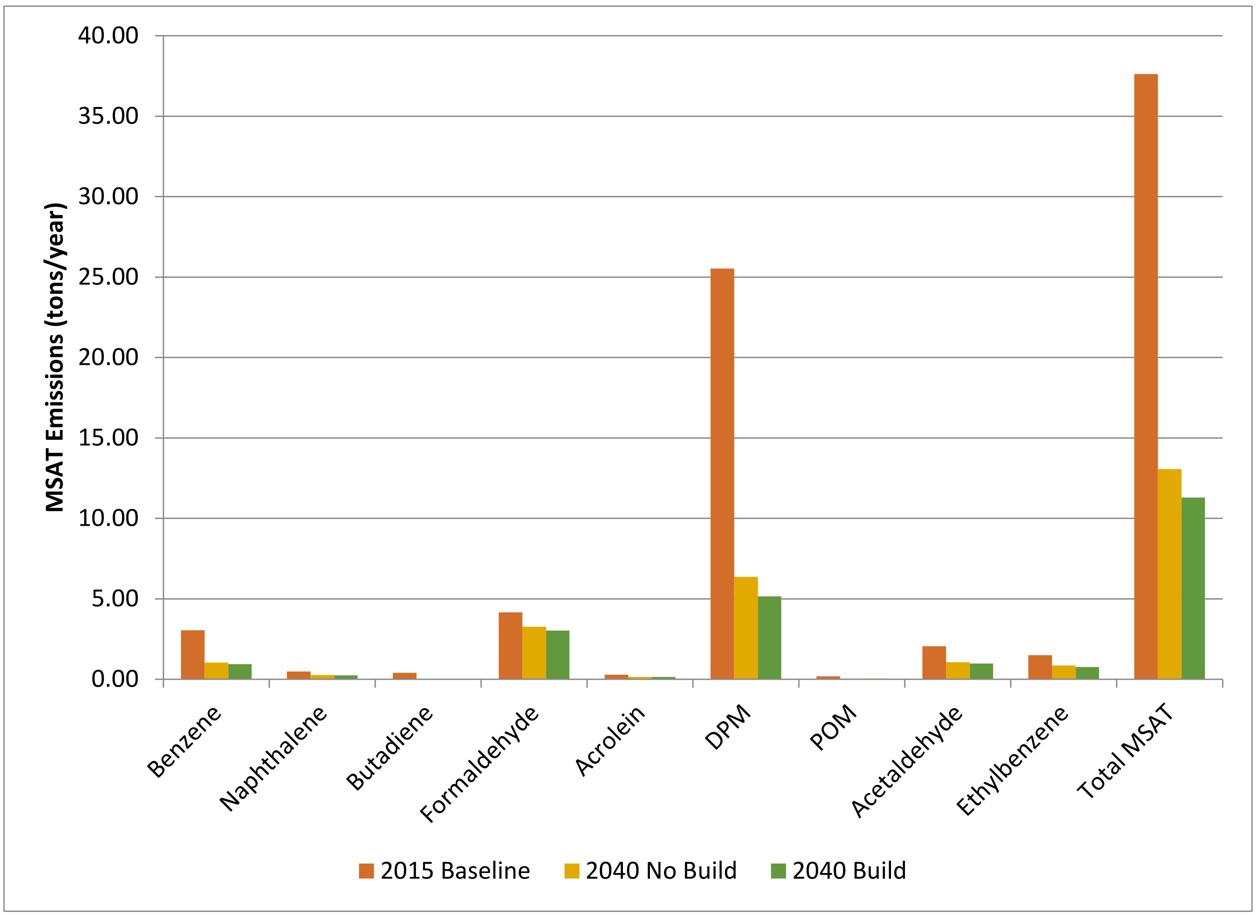

Figure 4-8. Projected Changes in MSAT Emissions over Time—*Alternative C*.

4.7.4 Environmental Consequences

4.7.4.1 Build Alternatives

CO TAQA

Local concentrations of CO are not expected to exceed national standards at any time under either of the *Build Alternatives*.

MSAT

Emissions of total MSAT are predicted to decrease by 70 percent from 2015 to 2040 under *Alternatives A* and *C*. This general trend is prevalent when comparing the annual emissions of the specific priority MSATs under the *Build* and *No Build Alternatives* in 2040 when compared with the existing year of 2015. In addition, although *Alternatives A* and *C* would increase the VMT by more than 150,000, when compared to the 2040 *No Build* conditions, the total MSAT emissions decrease by 13 percent. If emissions are plotted over time, a decreasing level of MSAT emissions can be seen from the base year (2015), although overall VMT continues to rise.

4.7.4.2 No Build

No improvements would be made to US 290/SH 71 through the project corridor under the *No Build Alternative*.

CO TAQA

Local concentrations of CO are not expected to exceed national standards at any time under the 2040 *No Build Alternative*.

MSAT

The analysis indicates that a 66 percent decrease in MSAT emissions can be expected for the *No Build Alternative* in 2040 when compared with the existing year of 2015.

4.7.4.3 Encroachment-Alteration Effects

Encroachment-alteration impacts on air quality from MSATs are unquantifiable due to existing limitations in determining pollutant emissions, dispersion, and impacts to human health. Emissions would likely be lower than present levels in future years as a result of the EPA's national air quality regulations (i.e., new light-duty and heavy-duty on-road fuel and vehicle rules, the use of low sulfur diesel fuel). Even with an increase in VMT and possible temporary emission increases related to construction activities, the EPA's vehicle and fuel regulations, coupled with fleet turnover, are expected to result in reductions of on-road emissions of MSATs and the ozone precursors VOC and NO_x over time. For these reasons, encroachment-alteration impacts on air quality are not anticipated as a result of the proposed project.

4.8 Traffic Noise Analysis

A *Noise Analysis Technical Report* was completed for the proposed project in October 2017. This report is included as **Appendix F** and uses projected traffic data that assumed tolled mainlanes. The results of this report are summarized below. The *Noise Analysis Technical Report* and this section of the DEIS will be updated before publication of the FEIS to reflect revised projected traffic data, based on TxDOT's and the Mobility Authority's decision to pursue non-tolled mainlanes for this project.

4.8.1 Background Information

The predominant land uses in the vicinity of the study area are residential, commercial, and transportation. The study area follows the proposed right-of-way running from east to west along and within the existing right-of-way of US 290 and SH 71.

Sound from highway traffic is generated primarily from a vehicle's tires, engine, and exhaust. It is commonly measured in decibels and is expressed as "dB."

Sound occurs over a wide range of frequencies. However, not all frequencies are detectable by the human ear; therefore, an adjustment is made to the high and low frequencies to approximate the way an average person hears traffic sounds. This adjustment is called A-weighting and is expressed as "dB(A)."

Also, because traffic sound levels are never constant due to the changing number, type, and speed of vehicles, a single value is used to represent the average or equivalent sound level and is expressed as "Leq."

The traffic noise analysis typically includes the following elements:

- Identification of land use activity areas that might be impacted by traffic noise
- Determination of existing noise levels
- Prediction of future noise levels
- Identification of possible noise impacts
- Consideration and evaluation of measures to reduce noise impacts

The FHWA has established the Noise Abatement Criteria (NAC) listed in **Table 4-14** for various land use activity areas that are used as one of two means to determine when a traffic noise impact would occur.

Absolute criterion: The predicted noise level at a receiver approaches, equals, or exceeds the NAC. Approach is defined as 1 dB(A) below the NAC. For example, a noise impact would occur at a Category B residence if the noise level is predicted to be 66 dB(A) or above.

Relative criterion: The predicted noise level substantially exceeds the existing noise level at a receiver even though the predicted noise level does not approach, equal, or exceed the NAC.

Substantially exceeds is defined as more than 10 dB(A). For example, a noise impact would occur at a Category B residence if the existing noise level is 54 dB(A) and the predicted noise level is 65 dB(A) (an 11 dB(A) increase).

Table 4-14. Noise Abatement Criteria

Activity Category	dB(A) Leq	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Residential.
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A–D or F.
F	--	Agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	Undeveloped lands that are not permitted.

Source: FHWA, 2017

When a traffic noise impact occurs, noise-abatement measures must be considered. A noise-abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area.

The FHWA traffic noise modeling software was used to calculate existing and predicted traffic noise levels. The model primarily considers the number, type, and speed of vehicles; highway alignment and grade; cuts, fills and natural berms; surrounding terrain features; and the locations of activity areas likely to be impacted by the associated traffic noise.

Existing and predicted traffic noise levels were modeled at receiver locations that represent the land use activity areas adjacent to the proposed project that might be impacted by traffic noise and that could potentially benefit from feasible and reasonable noise abatement. Result tables for the receivers in the study area are included in the *Noise Analysis Technical Report*, included as **Appendix F**.

4.8.2 Environmental Consequences

The proposed *Build Alternatives* would result in traffic noise impacts to receivers, as described in the following sections. Noise abatement measures including traffic management, alteration of horizontal and/or vertical alignments, acquisition of undeveloped property to act as a buffer zone, and the construction of noise barriers were considered.

Before any abatement measure can be proposed for incorporation into the project, it must be both feasible and reasonable. In order to be feasible, the abatement measure must be able to reduce the noise level at greater than 50 percent of impacted, first row receivers by at least 5 dB(A). To be reasonable, it must not exceed the cost-effectiveness criterion of $25,000 for each receiver that would benefit by a reduction of at least 5 dB(A), and the abatement measure must be able to reduce the noise level of at least one impacted, first row receiver by at least 7 dB(A).

Traffic management: Control devices could be used to reduce the speed of the traffic; however, the minor benefit of 1 dB(A) per 5 mph reduction in speed does not outweigh the associated increase in congestion and air pollution. Other measures such as time or use restrictions for certain vehicles are prohibited on state highways.

Alteration of horizontal and/or vertical alignments: Any alteration of the existing alignment would displace existing businesses and residences, require additional right-of-way, and not be cost effective/reasonable.

Buffer zone: The acquisition of undeveloped property to act as a buffer zone is designed to avoid rather than abate traffic noise impacts and, therefore, is not feasible.

Traffic noise barriers: This is the most commonly used noise abatement measure. Noise barriers were evaluated for each of the impacted receiver locations. It was then determined whether noise barriers would be reasonable and feasible.

To avoid noise impacts that may result from future development of properties adjacent to the project, local officials responsible for land use control programs must ensure, to the maximum extent possible, that no new activities are planned or constructed along or within the following predicted (2040) noise impact contours shown in **Table 4-15**. Due to the extreme geometry, changes in alignment, and changes in speed limit located throughout the project area, these distances are approximate.

Table 4-15. Worst-Case Impact Contour Distances for *Alternatives A* and *C*

Land Use	Impact Contour	Distance from Right-of-Way
NAC category B and C	66 dB(A)	≈ 495 feet
NAC category E	71 dB(A)	≈ 335 feet

Source: Project Team, 2017

A copy of this traffic noise analysis will be available to local officials. If a Build Alternative is selected, on the date of approval (Date of Public Knowledge), FHWA and TxDOT are no longer responsible for providing noise abatement for new development adjacent to the project.

Noise associated with the construction of the project is difficult to predict. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. None of the receivers is expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems.

4.8.2.1 Alternative A

Table 4-16 summarizes the change in dB(A) that would be expected at each receiver location with *Alternative A*, and **Figure 4-9a–e** show the locations of each receiver as well as proposed noise barriers. *Alternative A* would impact 128 of the 456 noise receivers analyzed. For detailed results of the Traffic Noise Analysis, see the *Noise Analysis Technical Report* that was prepared for the OHP Project and included as **Appendix F**.

Table 4-16. Summary of Predicted 2040 Noise Level Change for *Alternative A*

Noise Impact	NAC Activity Category/ Acceptable dB(A) Leq	Change (+/-)	Representative Receivers
No	B / 67	-8 to -4	R27, R28, R29, R30, R31, R32, R33, R102-1, R103-2, R104, R259, R261, R262, R263, R264, R266, R269, R274, R275, R281, R282
		-3	R92, R96, R97, R102-2, R103-1, R265, R276, R279, R280, R283, R286, R287, R288
		-2	R38, R39, R43-1, R93, R98, R105, R123, R128, R258, R267-1, R268, R272, R273, R277, R278, R289, R290, R291, R292
		-1	R37, R41, R42, R43-2, R43-3, R71, R83, R84, R85, R88, R89, R90, R94, R106, R107, R115, R116, R117, R118, R119, R120, R121, R122, R124, R125, R127, R129, R130, R131, R270, R271, R284, R285, R293, R294
		0	R35, R59, R60, R68, R69, R70, R72, R76, R79, R80, R86, R87, R141, R233, R301
		+1	R16, R44, R50, R53, R54, R55, R56, R57, R61, R62, R63, R64, R65, R66, R67, R73, R74, R75, R77, R78, R112, R113, R142, R143, R145, R193, R196, R198, R222, R223, R224, R225, R229, R230, R231, R232, R236, R237, R295, R296, R297, R298, R441-1
		+2	R12, R13, R17, R21, R22, R23, R24, R25, R34, R45, R46, R47, R48, R49, R51, R52, R111, R133, R139, R144, R169, R170, R174, R176, R177, R178, R179, R180, R181, R182, R183, R185, R187, R188, R189, R190, R192, R194, R195, R197, R199, R200, R201, R202, R203, R204, R214, R215, R216, R221, R226, R227, R228, R253, R300, R316, R336, R338, R344
		+3	R2-1, R2-2, R11, R20, R132, R134, R137, R138, R140, R163, R164, R165, R171, R172, R173, R175, R184, R186, R191, R205, R206, R208, R217, R218, R219, R220, R235, R241, R251, R252, R256-1, R302, R317, R318, R319, R324, R325, R334, R335, R339, R340, R341, R342, R43, R345, R354, R355, R356, R357, R358, R359, R371, R376, R377, R378, R379, R380, R401, R402, R413, R415, R416, R417
		+4	R207, R209, R210, R211, R212, R240, R243, R244, R247, R248, R249, R250, R315, R320, R321, R322, R383, R384, R388, R392, R394, R396, R398, R399, R400, R414, R436
		+5	R239, R242, R245, R246, R303, R323, R390, R391, R393, R395, R397, R234
Yes	B / 67	-2 to 0	R36, R81, R82, R91, R95-1, R95-2, R109, R361
		+1	R1, R99, R362
		+2	R19, R26, R167, R267-2, R331, R332, R333, R337, R360, R363, R364, R365, R366, R441-2
		+3	R2-3, R135, R153, R154, R161, R162, R166, R168, R299, R329, R330, R367, R368, R369, R370, R373, R374, R381, R411, R424, R429, R430, R434

Noise Impact	NAC Activity Category/ Acceptable dB(A) Leq	Change (+/-)	Representative Receivers
		+4	R5, R6, R7, R8, R9, R136, R146, R147, R148, R149, R150, R151, R152, R155, R156, R157, R158, R159, R160, R304, R305, R306, R326, R327, R328, R351, R372, R375, R382, R385, R404, R405, R406, R407, R408, R409, R410, R412, R418, R419, R420, R422, R423, R425. R426, R427, R428, R431, R432, R433, R435
		+5	R10, R213, R267-3, R308, R309, R310, R314, R386, R387, R389, R403, R421
		+6	R307, R311, R313
		+7	R238, R256-2, R312
		+8	R256-3
No	C / 67	-3	R101
		-2	R40, R126
		+2	R255
		+3	R257, R439, R440
		+5	R347
Yes	C / 67	-3	R114
		+2	R352, R353, R442
		+3	R3, R438
		+4	R4, R437
		+6	R348
		+7	R349
No	D / 52	-3 to 0	R58, R100, R260
		+2	R110
		+3	R18, R346
		+5	R254
No	E / 72	-3 to 0	R108, R444

Noise Impact	NAC Activity Category/ Acceptable dB(A) Leq	Change (+/-)	Representative Receivers
		+2	R15, R443
		+8	R350
Yes	E / 72	+4	R14

Source: Project Team, 2017

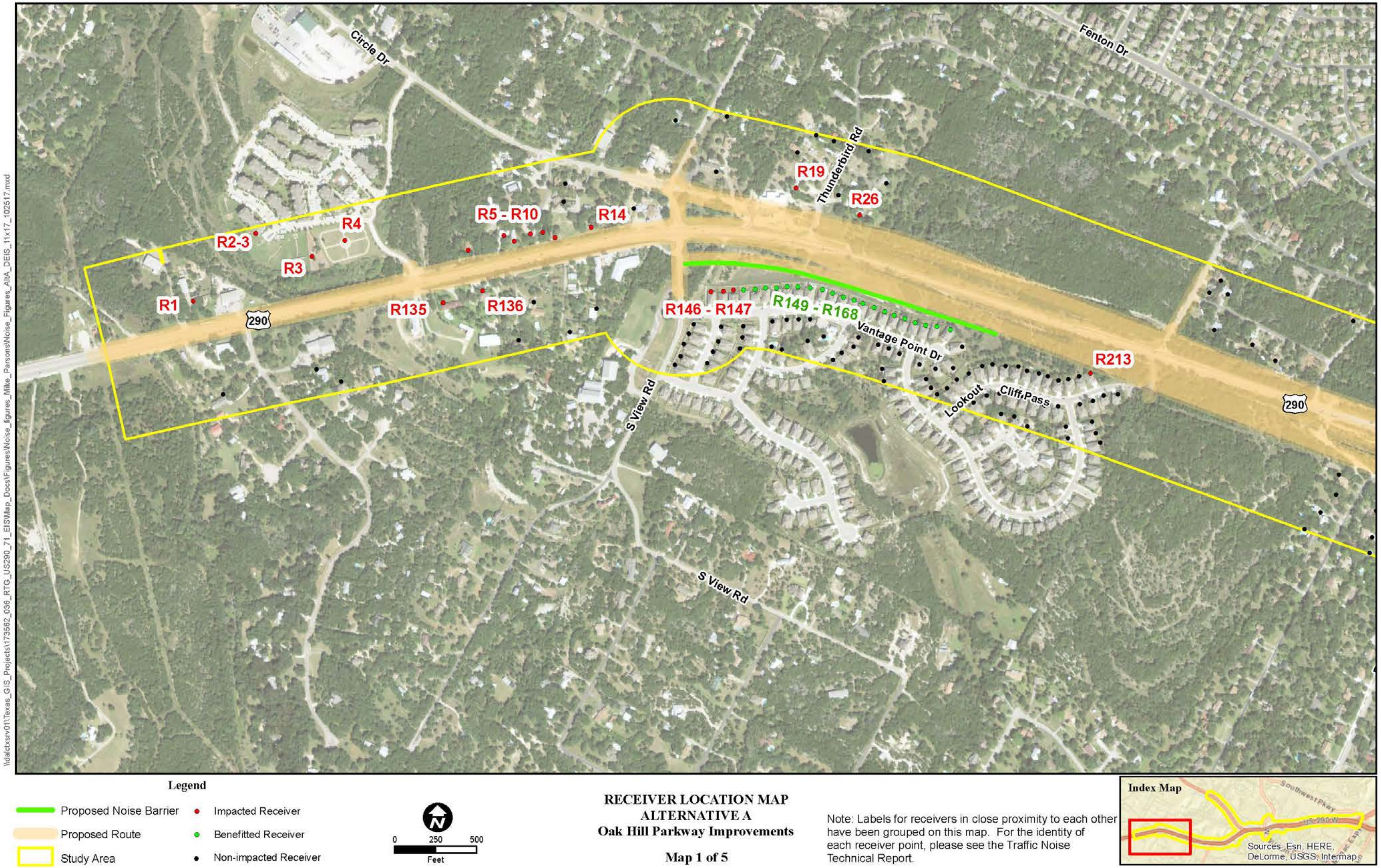

Figure 4-9a. Receiver location map for *Alternative A*.

Figure 4-9b. Receiver location map for *Alternative A*.

Figure 4-9c. Receiver location map for *Alternative A*.

Figure 4-9d. Receiver location map for *Alternative A.*

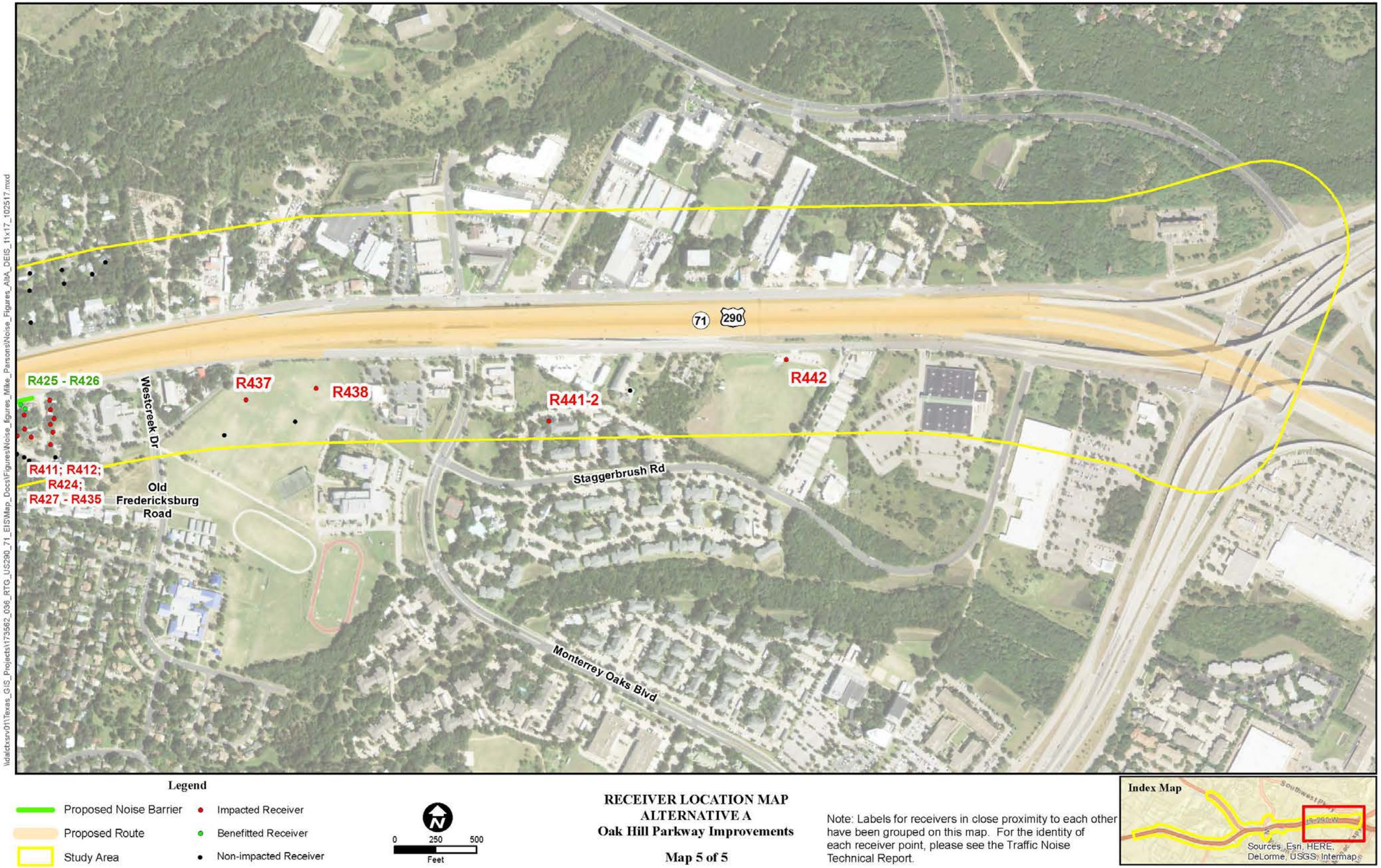

Figure 4-9e. Receiver location map for *Alternative A.*

Traffic noise barriers would not be feasible and reasonable for any of the following impacted receivers (76 total) and, therefore, are not proposed for incorporation into the project.

R1: This receiver represents a single impacted residence with a driveway facing the roadway. A continuous traffic noise barrier would restrict access to this residence. Gaps in a traffic noise wall would satisfy access requirements, but the resulting non-continuous wall segments would not be sufficient to achieve the minimum, feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R2–3, R3, R4; These receivers represent two impacted third-floor apartments and two dog parks. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R5–R10, R14: These receivers represent seven impacted residences. A traffic noise barrier placed along the right-of-way line varying in height from 10 to 20 feet was evaluated in this area in an attempt to shield these impacted residences. A traffic noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at each of these receivers would exceed the reasonable cost-effectiveness criterion of $25,000.

R19: This receiver represents a single impacted residence. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R26 and R36: These receivers are separate, individual residences. Traffic noise walls that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at each of these receivers would exceed the reasonable cost-effectiveness criterion of $25,000.

R81 and R82: These receivers represent two impacted residences. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R91: This receiver represents a single impacted residence. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R95-1, R95-2 and R99: These receivers represent 128 first- and second-story receivers at Settler's Creek Apartments and a single impacted residence; 10 of these are first-row impacted receivers. A traffic noise barrier placed along the right-of-way line varying in height from 10 to 20 feet was evaluated in this area in an attempt to shield these impacted residences. A traffic noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal exceeds the reasonable cost-effectiveness criterion of $25,000 per benefited receiver.

R109 and R114: These receivers represent single impacted residences with driveways facing the roadway. A continuous traffic noise barrier would restrict access to these residences. Gaps in a noise wall would satisfy access requirements but the resulting non-continuous wall segments would not be sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R135 and R136: These receivers represent two impacted residences. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R213: This receiver is a separate, individual residence. A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal would exceed the reasonable cost-effectiveness criterion of $25,000.

R238: This receiver represents a single impacted residence. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the dB(A) noise reduction design goal.

R299, R304–R314: These receivers represent 12 impacted residences located on a cliff overlooking US 290; their location makes designing an effective traffic noise barrier difficult. Due to this reason, as well as breaks in the barrier for frontage road access and multiple elevated mainline structures, a traffic noise barrier could not be designed to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R326–R333, R337: These receivers represent nine impacted residences. A traffic noise barrier placed along the William Cannon Drive right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R348 and R349: These receivers represent two common areas at a cemetery. A traffic noise barrier, up to 20 feet in height placed along the right-of-way line was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R352: This receiver represents impacted recreational land use in the area. Due to breaks in the barrier for access, a traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R353: This receiver represents a single impacted receiver (an outdoor activity area associated with a church). A traffic noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at this receiver would exceed the reasonable cost-effectiveness criterion of $25,000 per benefited receiver.

R360–R370, R372–R375, R381–R382, R385–R387, R389: These receivers represent 21 impacted residences. Multiple barrier configurations were evaluated in this area in an attempt to design a feasible and reasonable traffic noise barrier. A traffic noise barrier placed along the right-of-way line, between 10 and 20 feet in height and between 477 and 1,681 feet in length that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal for this entire area would exceed the reasonable cost-effectiveness criterion of $25,000.

R437 and R438: These receivers represent impacted recreational land uses in the area. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R441-2: This receiver represents the Monterey Ranch Apartments second-story units. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R442: This receiver represents impacted recreational land use in the area. Due to breaks in the barrier for access, a traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

Traffic noise barriers would be feasible and reasonable for the following impacted receivers (52 total) and, therefore, are proposed for incorporation into the project.

R146–R162, R166–R168: These receivers represent 20 impacted residences, all of which are first-row impacted receivers. Based on preliminary calculations, a traffic noise barrier 1,951 feet in length and 14 feet in height would reduce noise levels by at least 5 dB(A) for 17 first-row impacted receivers and 3 additional benefited receivers at a total cost of $491,652, or $24,583 for each benefited receiver. Additionally, 4 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R256-2 and R256-3: Receiver 256 represents 168 first-, second-, and third-story receivers at Vineyard Hills Apartments. In this area, 24 receivers are impacted, of which 20 are first-row receivers. Based on preliminary calculations, a traffic noise barrier 599 feet in length and 20 feet in height would reduce noise levels by at least 5 dB(A) for 13 first-row impacted receivers and 6 additional benefited receivers at a total cost of $215,640, or $11,349 for each benefited receiver. As well, 11 of the first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R267-2 and R267-3: Receiver 267 represents 162 first-, second-, and third-story receivers at Bell Quarry Hill Apartments. In this area, 47 receivers are impacted, of which 44 are first-row receivers. Based on preliminary calculations, a traffic noise barrier 842 feet in length and 20 feet in height would reduce noise levels by at least 5 dB(A) for 37 first-row impacted receivers and 10 additional benefited receivers at a total cost of $303,120, or $6,449 for each benefited receiver. As well, 27 of the first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R403–R412, R418–R435: These receivers represent 28 impacted residences, of which 5 are first-row receivers. Based on preliminary calculations, a traffic noise barrier 667 feet in length and 19 feet in height would reduce noise levels by at least 5 dB(A) for 4 first-row impacted receivers and 10 additional benefited receivers at a total cost of $228,114, or $16,294 for each benefited receiver. As well, 4 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

Table 4-17 summarizes the proposed traffic noise barriers for *Alternative A*.

Table 4-17. Traffic Noise Barrier Proposal (Preliminary)—*Alternative A*

Barrier	Representative Receivers	Total # Benefited	Length (ft)	Height (ft)	Total Cost	Cost per Benefited Receiver
A1	R146–R162, R166–R168	20	1,951	14	$491,652	$24,583
A2	R256-2, R256-3	19	559	20	$215,640	$11,349
A3	R267-2, R267-3	47	842	20	$303,120	$6,449
A4	R403–R412, R418–R435	14	667	19	$228,114	$16,294

Source: Project Team, 2017

Alternative A would propose 4 noise barriers for 52 receivers. Any subsequent project design changes may require a reevaluation of this preliminary traffic noise barrier proposal. The final decision to construct the proposed traffic noise barrier would not be made until completion of the project design, utility evaluation, and polling of property owners who are adjacent to the proposed noise barrier locations where abatement was determined to be reasonable and feasible. Prior to construction, noise workshops would be conducted with affected stakeholders to discuss noise mitigation measures.

4.8.2.2 Alternative C

Table 4-18 summarizes the change in dB(A) that would be expected at each receiver location with *Alternative C*, and **Figure 4-10a–e** shows the locations of each receiver as well as the location of proposed noise barriers. *Alternative C* would impact 113 of the 456 noise receivers analyzed. For detailed results of the Traffic Noise Analysis, see the *Noise Analysis Technical Report* that was prepared for the OHP Project and included as **Appendix F**.

Table 4-18. Summary of Predicted 2040 Noise Level Change for *Alternative C*

Noise Impact	NAC Activity Category/ Acceptable dB(A) Leq	Change (+/-)	Representative Receivers
No	B / 67	-8 to -4	R31 (B/C), R102-1, R103-2, R259, R261, R262, R263, R264, R266, R269, R274, R275, R279, R280, R281, R282, R283, R286, R287, R288, R290,
		-3	R27, R32, R39, R92, R96, R97, R102-2, R103-1, R265, R272, 276, R278, R289, R291, R292
		-2	R29, R30, R41, R42, R43-1, R93, R98, R105, R258, R267-1, R268, R273, R277, R284, R285, R293, R294
		-1	R28, R43-2, R43-3, R59, R60, R71, R83, R84, R85, R88, R89, R90, R94, R106, R107, R270, R271
		0	R16, R33, R38, R50, R53, R54, R55, R56, R57, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R72, R73, R76, R79, R80, R86, R87, R111, R112, R113, R115, R116, R117, R118, R119, R120, R121, R122, R124, R141, R143, R145
		+1	R2-1, R2-2, R2-3, R12, R13, R17, R19, R21, R22, R44, R45, R46, R47, R48, R49, R51, R52, R74, R75, R77, R78, R123, R125, R127, R128, R129, R131, R132, R133, R134, R137, R138, R139, R140, R142, R144, R170, R171, R174, R177, R180, R181, R182, R183, R184, R185, R187, R188, R189, R190, R193, R329, R330, R441-1
		+2	R6, R8, R11, R20, R23, R24, R25, R35, R37, R130, R146, R147, R149, R150, R152, R157, R158, R159, R161, R162, R172, R173, R175, R176, R178, R179, R186, R191, R192, R198, R233, R253, R256-1, R315, R326, R327, R328, R334, R335, R336, R338, R339, R340, R341, R342, R343, R344, R345
		+3	R34, R148, R151, R163, R164, R165, R194, R195, R196, R197, R199, R200, R201, R202, R203, R214, R215, R216, R224, R226, R227, R228, R229, R230, R231, R232, R251, R252, R324, R356, R357, R358, R359, R371, R378, R379, R380, R413, R415, R416, R417, R435
		+4	R169, R204, R205, R206, R208, R217, R218, R219, R220, R221, R222, R223, R236, R237, R248, R249, R250, R301, R325, R351, R354, R355, R377, R383, R384, R392, R394, R399, R401, R402, R414, R436
		+5	R207, R209, R210, R211, R240, R241, R243, R244, R246, R247, R297, R298, R316, R317, R318, R319, R321, 322, R323, R390, R391, R393, R395, R396, R397, R398, R400
		+6	R235, R242, R245, R302, R320
		+7	R239
Yes	B / 67	-3 to 0	R1, R36, R81, R82, R91, R95-1, R95-2, R104, R109,
		+1	R99, R135, R154, R331, R332, R333, R361
		+2	R5, R7, R9, R10, R26, R136, R153, R155, R156, R160, R267-2, R314, R337, R362, R363, R364, R366, R441-2
		+3	R166, R167, R306, R310, R360, R365, R367, R368, R370, R374, R411, R419, R420, R424, R425, R429, R430, R431, R432, R433, R434

Noise Impact	NAC Activity Category/ Acceptable dB(A) Leq	Change (+/-)	Representative Receivers
		+4	R168, R225, R305, R308, R309, R311, R312, R369, R372, R373, R375, R376, R381, R382, R404, R405, R406, R407, R408, R409, R410, R412, R418, R421, R422, R423, R426, R427, R428
		+5	R267-3, R295, R296, R300, R304, R307, R313, R385, R386, R387, R388, R389, R403
		+6	R212, R299
		+7	R213, R256-2
		+8	R234, R238, R256-3
		+10	R303
No	C / 67	-3	R101
		-2	R40, R114
		+1	R3
		+2	R255, R442
		+3	R257, R352
		+4	R437
		+5	R348
Yes	C / 67	+1	R126
		+2	R4
		+3	R353, R438, R439, R440
		+4	R347
		+7	R349
No	D / 52	–3 to 0	R100, R260
		+1	R18, R58
		+2	R110, R346
		+5	R254
No	E / 72	-3 to 0	R444, R108
		+1	R15
		+2	R14, R443
		+8	R350

Source: Project Team, 2017

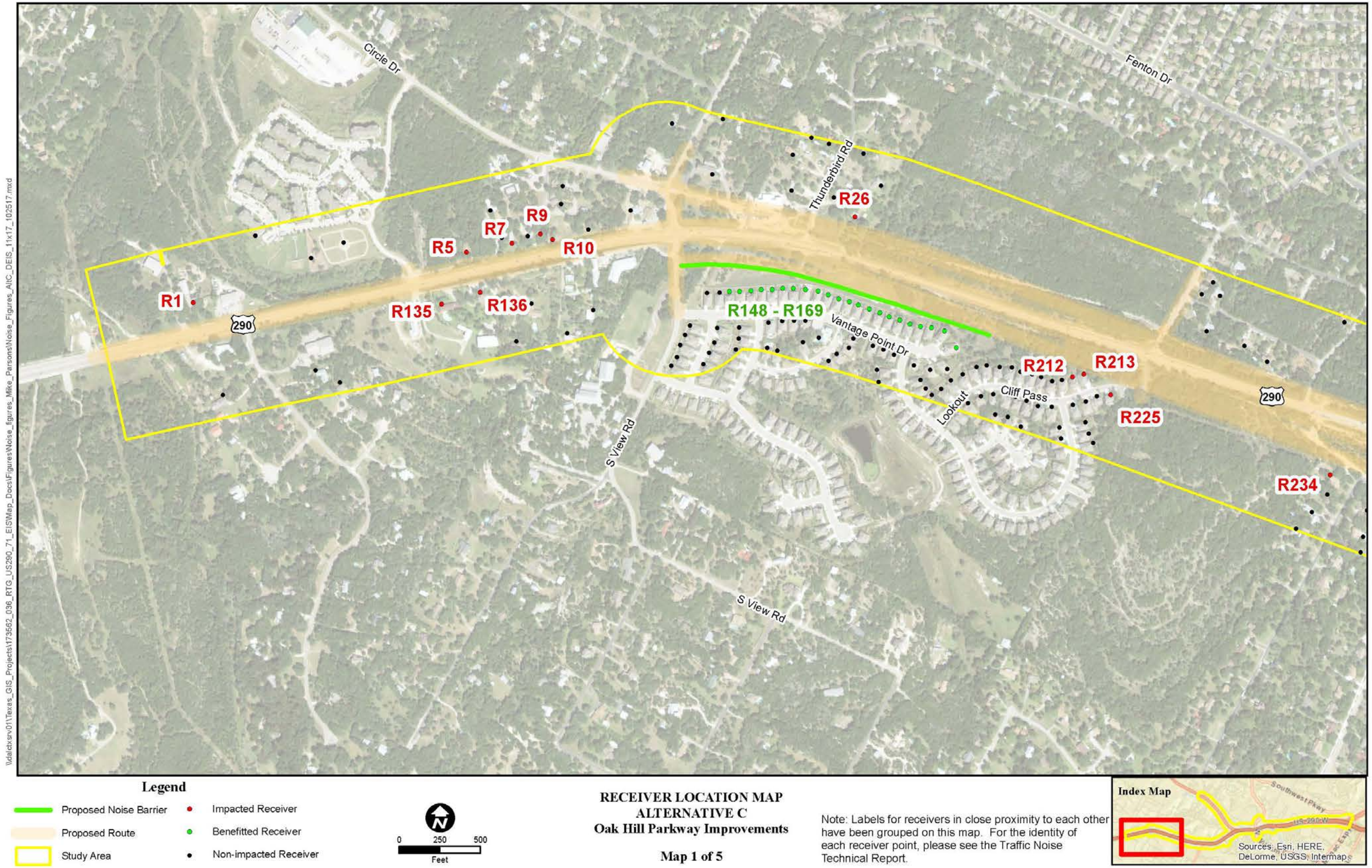

Figure 4-10a. Receiver location map for *Alternative C*.

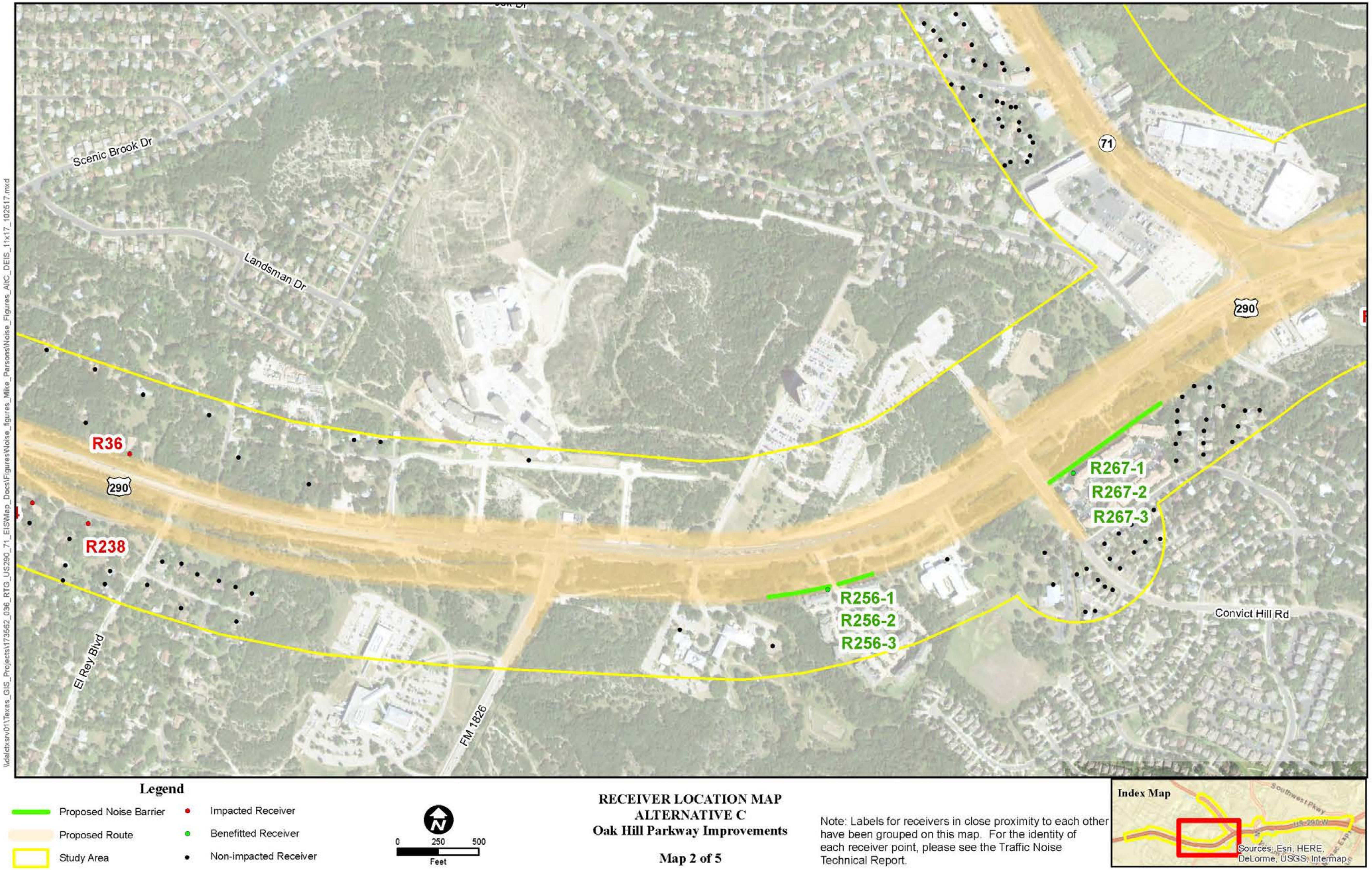

Figure 4-10b. Receiver location map for *Alternative C*.

Figure 4-10c. Receiver location map for *Alternative C.*

Figure 4-10d. Receiver Location Map for *Alternative C.*

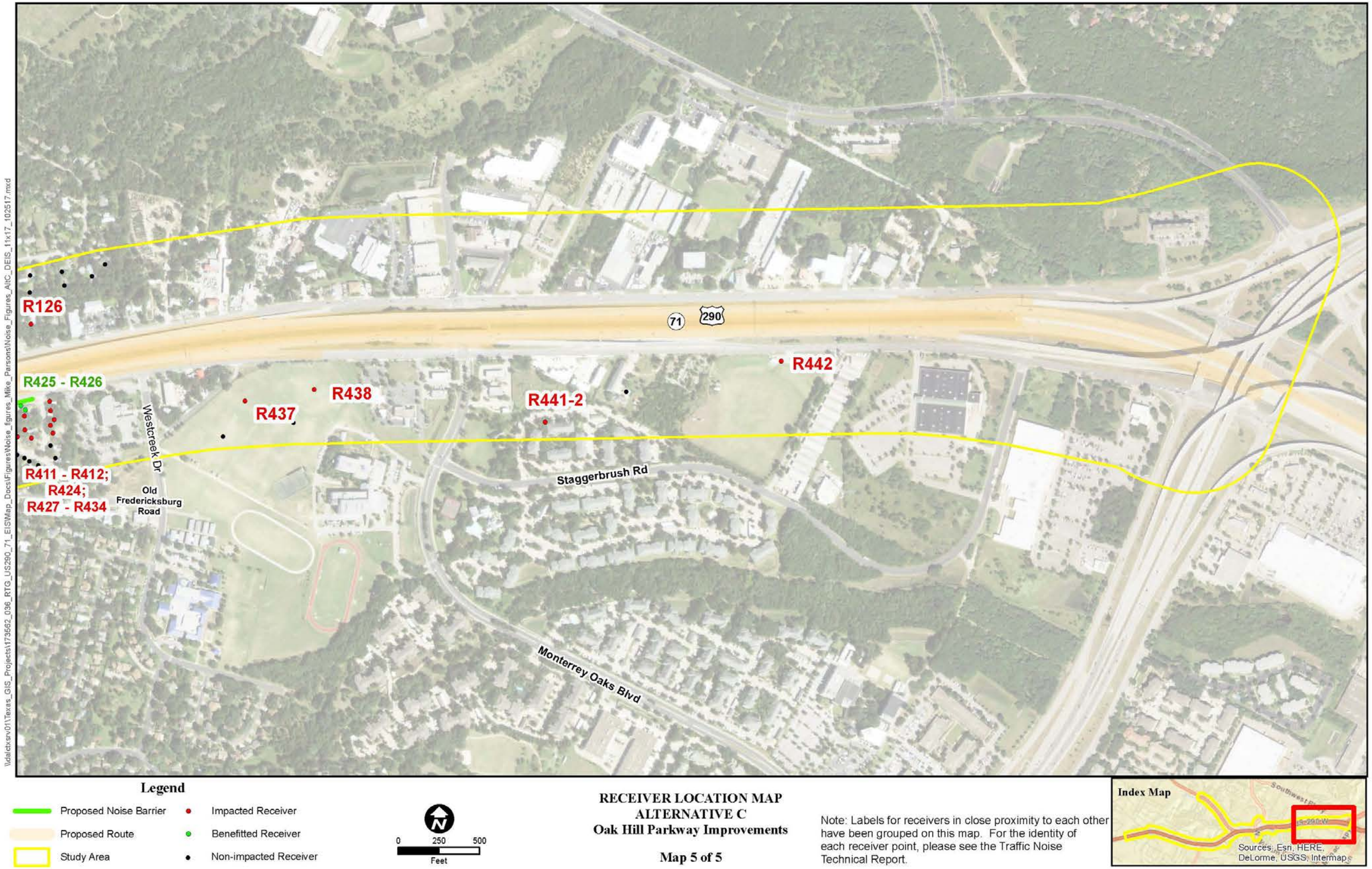

Figure 4-10e. Receiver location map for *Alternative C.*

Traffic noise barriers would not be feasible and reasonable for any of the following impacted receivers (74 total) and, therefore, are not proposed for incorporation into the project.

R1: This receiver represents a single impacted residence with a driveway facing the roadway. A continuous traffic noise barrier would restrict access to this residence. Gaps in a traffic noise wall would satisfy access requirements but the resulting non-continuous wall segments would not be sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R5, R7, R9, R10: These receivers represent 4 impacted residences. A traffic noise barrier placed along the right-of-way line varying in height from 10 to 20 feet was evaluated in this area attempting to shield these impacted residences. A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at each of these receivers would exceed the reasonable cost-effectiveness criterion of $25,000.

R26: This receiver represents a single impacted residence. A traffic noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at this receiver would exceed the reasonable cost-effectiveness criterion of $25,000.

R36: This receiver represents a single impacted residence. A traffic noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at this receiver would exceed the reasonable cost-effectiveness criterion of $25,000.

R81 and R82: These receivers represent 2 impacted residences. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R91: This receiver represents a single impacted residence. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R95-1, R95-2 and R99: These receivers represent 128 first- and second-story receivers at Settler's Creek Apartments and a single impacted residence, of which 10 are first-row impacted receivers. Based on preliminary calculations, a traffic noise barrier 615 feet in length and 20 feet in height would reduce noise levels by at least 5 dB(A) for 10 first-row impacted receivers and 13 additional benefited receivers at a total cost of $221,400, or $9,626 for each benefited receiver. As well, 10 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R104: This receiver represents 77 mobile home sites in the Country Aire Mobile Home Park. Of these receivers, 4 are impacted sites, all of which are first-row receivers. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) at greater than 50 percent of the first–row impacted receivers.

R109 and R114: These receivers represent a single impacted residence and the YMCA, both with driveways facing the roadway. A continuous traffic noise barrier would restrict access to these residences. Gaps in a traffic noise wall would satisfy access requirements but the resulting non-continuous wall segments would not be sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R126: This receiver represents a single impacted school with direct driveway access to the service road creating a gap in the traffic noise barrier. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R135 and R136: These receivers represent 2 impacted residences. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R212, R213, R225: These receivers represent 3 impacted residences. A traffic noise barrier placed along the right-of-way line varying in height from 10 to 20 feet was evaluated in this area in an attempt to shield these impacted residences. A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at each of these receivers would exceed the reasonable cost-effectiveness criterion of $25,000.

R234: This receiver represents a single impacted residence. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the dB(A) noise reduction design goal.

R238: This receiver is a separate, individual residence. A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal would exceed the reasonable cost-effectiveness criterion of $25,000.

R295, R296, R299, R300, R303–R314: These receivers represent 16 impacted residences located on a cliff overlooking US 290. Their location makes designing an effective traffic noise barrier difficult. Due to this reason, as well as breaks in the barrier for frontage road access and multiple elevated mainline structures, a traffic noise barrier could not be designed to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R331–R333, R337: These receivers represent 4 impacted residences. A traffic noise barrier placed along the William Cannon Drive right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R349: This receiver represents a common area at a cemetery. A traffic noise barrier, up to 20 feet in height placed along the right-of-way line was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R352: This receiver represents impacted recreational land use in the area. Due to breaks in the barrier for access, a traffic noise barrier placed along the right-of-way line, up to 20 feet in height, could not be designed to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R353: This represents a single impacted receiver (an outdoor activity area associated with a church). A noise wall that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal at this receiver would exceed the reasonable cost-effectiveness criterion of $25,000 per benefited receiver.

R360–R370, R372–R376, R381–R382, R385–R389: These receivers represent 23 impacted residences. Multiple barrier configurations were evaluated in this area in an attempt to design a feasible and reasonable traffic noise barrier. A traffic noise barrier placed along the right-of-way line, between 10 and 20 feet in height and between 477 and 1,681 feet in length that would achieve the minimum feasible reduction of 5 dB(A) while achieving a 7 dB(A) noise reduction design goal for this entire area would exceed the reasonable cost-effectiveness criterion of $25,000 per benefited receiver.

R437–R438: These receivers represent impacted recreational land uses in the area. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R441-2: This receiver represents the Monterey Ranch Apartments second-story units. A traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) while achieving the 7 dB(A) noise reduction design goal.

R442: This receiver represents impacted recreational land use in the area. Due to breaks in the barrier for access, a traffic noise barrier placed along the right-of-way line, up to 20 feet in height, was not sufficient to achieve the minimum feasible reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

Traffic noise barriers would be feasible and reasonable for the following impacted receivers (39 total) and, therefore, are proposed for incorporation into the project.

R153–R156, R160, R166–R168: These receivers represent 8 impacted residences, all of which are first-row receivers. Based on preliminary calculations, a traffic noise barrier 1,951 feet in length and 15 feet in height would reduce noise levels by at least 5 dB(A) for the 8 first-row impacted receivers and an additional 14 benefited receivers at a total cost of $526,770, or $23,944 for each benefited receiver. As well, 5 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R256-2 and R256-3: Receiver 256 represents 168 first-, second-, and third-story receivers at Vineyard Hills Apartments. In this area, 24 receivers are impacted, of which 20 are first-row receivers. Based on preliminary calculations, a traffic noise barrier 599 feet in length and 20 feet in height would reduce noise levels by at least 5 dB(A) for 13 first-row impacted receivers and 6 additional benefited receivers at a total cost of $215,640, or $11,349 for each benefited receiver. As well, 11 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R267-2 and R267-3: Receiver 267 represents 162 first-, second-, and third-story receivers at Bell Quarry Hill Apartments. In all, 47 receivers are impacted in this area, of which 43 are first-row receivers. Based on preliminary calculations, a traffic noise barrier 842 feet in length and 20 feet in height would reduce noise levels by at least 5 dB(A) for 36 first-row impacted receivers and 10 additional benefited receivers at a total cost of $303,120, or $6,590 for each benefited receiver. As well, 27 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

R403–R412, R418–R434: These receivers represent 27 impacted residences, of which 5 are first-row receivers. Based on preliminary calculations, a traffic noise barrier 667 feet in length and 17 feet in height would reduce noise levels by at least 5 dB(A) for 4 first-row impacted receivers and 10 additional benefited receivers at a total cost of $204,102, or $14,579 for each benefited receiver. As well, 4 first-row impacted receivers are predicted to meet the TxDOT noise reduction design goal of 7 dB(A) or more.

Table 4-19 summarizes the proposed traffic noise barriers for *Alternative C*.

Table 4-19. Traffic Noise Barrier Proposal (Preliminary)—*Alternative C*

Barrier	Representative Receivers	Total # Benefited	Length (ft)	Height (ft)	Total Cost	Cost per Benefited Receiver
C1	R153–R156, R160, R166–R168	22	1,951	15	$526,770	$23,944
C2	R256-2, R256-3	19	599	20	$215,640	$11,349
C3	R267-2, R267-3	46	842	20	$303,120	$6,590
C4	R403–R412, R418–R434	14	667	17	$204,102	$14,579

Source: Project Team, 2017

Alternative C would propose 4 noise barriers for 39 receivers. Any subsequent project design changes may require a reevaluation of this preliminary traffic noise barrier proposal. The final decision to construct the proposed traffic noise barrier would not be made until completion of the project design, utility evaluation, and polling of property owners who are adjacent to the proposed noise barrier locations where abatement was determined to be reasonable and feasible. Prior to construction, noise workshops would be conducted with affected stakeholders to discuss noise mitigation measures.

4.8.2.3 No Build Alternative

With the *No Build Alternative*, the proposed improvements would not be constructed. Over time, traffic volumes on the existing roadways would be expected to increase and would likely result in an increase in traffic noise levels.

4.8.2.4 Encroachment-Alteration Effects

Increases in traffic noise levels resulting from the proposed project are considered a direct effect and were analyzed in the traffic noise analysis (discussed above). Additional noise impacts, in the form of encroachment-alteration effects, are not anticipated as a result of the proposed project.

4.9 Water Resources

4.9.1 Edwards Aquifer/Groundwater Resources

The following sections describe the existing conditions and proposed impacts to groundwater resources within the project area. This information is summarized from the OHP Project *Water Resources Technical Report* which is included as **Appendix G**.

4.9.1.1 Existing Conditions

The geology of the OHP Project area is a typical representation of karst topography (eroded limestone) in Central Texas (see **Section 4.4**). The geologic framework of Central Texas creates the foundation for an underground layer of water-bearing permeable rock known as an aquifer. The OHP Project area is situated over two aquifers: the Trinity Aquifer and the Edwards Balcones Fault Zone Aquifer (Edwards Aquifer). Aquifers are generally recharged by direct precipitation on the land surface, but several factors, including topography, streamflow characteristics, soils, geology, faulting, land-use, and distribution of precipitation, will impact the amount of water that is recharged into or discharged from the aquifer (Ryder, 1996). Karst landscapes have unique hydrogeology that results in aquifers that are highly productive but extremely vulnerable to contamination (Mahler and Massei, 2007). Most of the recharge in karst regions occurs as point recharge into solution cavities or karst features. These features often form a network of subterranean flow paths that allow for rapid transportation through the aquifer. Rapid transportation typically results in short residence times and little to no filtration, which minimizes the opportunity for sediment, pathogens, and chemicals to settle out, degrade, or become inert (Mahler, Musgrove, Herrington, et al., 2011). The Edwards and Trinity Aquifers are interconnected and groundwater flow paths trend towards the Balcones Escarpment (fault zone).

The Trinity Aquifer is a major aquifer which extends across much of the central and northeastern parts of Texas (Barker and Ardis, 1996). This area includes all or parts of 61 counties, from the Red River in North Texas to the Hill Country of south-central Texas. The Trinity Aquifer recharges slowly, with only 4–5 percent of precipitation recharging to the aquifer (Eckhardt, 2016). Additionally, the Trinity Aquifer contributes a significant amount of water as recharge to the Edwards Aquifer each year (Eckhardt, 2016). This recharge can occur where the geologic layers of the two aquifers are juxtaposed by faults, or by upwelling from the Trinity Aquifer into the Edwards Aquifer.

The Edwards Aquifer is a major aquifer located in the south-central part of the state and crosses eight Texas counties: Williamson, Travis, Hays, Comal, Bexar, Medina, Uvalde, and Kinney. The Edwards Aquifer is primarily composed of partially dissolved limestone in thicknesses ranging from 200 to 600 feet and is highly permeable with sinkholes, caves, surface faults, and fractures. As a result, water levels and spring flows within the Edwards Aquifer respond quickly to rainfall, drought, and pumping. The Edwards Aquifer is comprised of three segments: Northern Segment, Barton Springs Segment, and San Antonio Segment; the OHP Project crosses the Barton Springs Segment of the aquifer.

The Edwards Aquifer includes a saline zone and four freshwater zones: the Contributing Zone, the Recharge Zone, the Transition/Artesian Zone, and the Contributing Zone within the Transition Zone. **Table 4-20** defines and describes these zones and provides the acreage of each zone that occurs within the OHP Project area. Of the total OHP Project area, approximately 64 percent lies within the Contributing Zone and 36 percent is located in the Recharge Zone (**Figure 4-11**).

Table 4-20. Edwards Aquifer Zones in the OHP Project Area

Edwards Aquifer Zone	Description	Acreage Within Project Area
Contributing Zone	Water from the Contributing Zone flows over relatively impermeable limestones until it reaches the Recharge Zone. The Contributing Zone is located on the Edwards Plateau and catches water from rainfall events in streams that flow into the Recharge Zone. The Contributing Zone within the Edwards Plateau generally occurs in the Texas Hill Country. This zone is about 5,400 square miles, with elevations ranging between 1,000 and 2,300 feet above sea level. Rainfall averages about 30 inches per year in this zone, and water runs off into streams or infiltrates into the water table.	255.55
Recharge Zone	The Recharge Zone is an area where highly fractured and faulted Edwards limestones outcrop at the land surface allowing large quantities of water to flow into the aquifer. The aquifer in the Recharge Zone is unconfined and has a water table that rises and falls in response to rainfall. Water works its way down by gravity into the transition/artesian zone. The Recharge Zone is about 1,250 square miles and is located along the Balcones Fault. About 75–80 percent of the recharge occurs when streams and rivers cross the porous formation and go underground. The remaining recharge amount is the result of precipitation.	140.09
Transition Zone	The Transition/Artesian Zone includes a thin strip of land south and southeast of the Recharge Zone from San Antonio to Austin. Limestones that overlie the Edwards Aquifer in this area are faulted and fractured and have caves and sinkholes that allow surface water entry into the aquifer.	0.00
Contributing Zone within Transition Zone	The Contributing Zone is composed of topographically high elevation areas within the Transition Zone where runoff drains to streams that flow over the Recharge Zone.	0.00

Edwards Aquifer Zone	Description	Acreage Within Project Area
Saline Zone	The Saline Zone is an area of high salinity that does not contain potable water. The "bad water line" delineating the Saline Zone is defined as the point at which total dissolved solids reaches 1,000 parts per million.	0.00

Source: Eckhardt, 2016

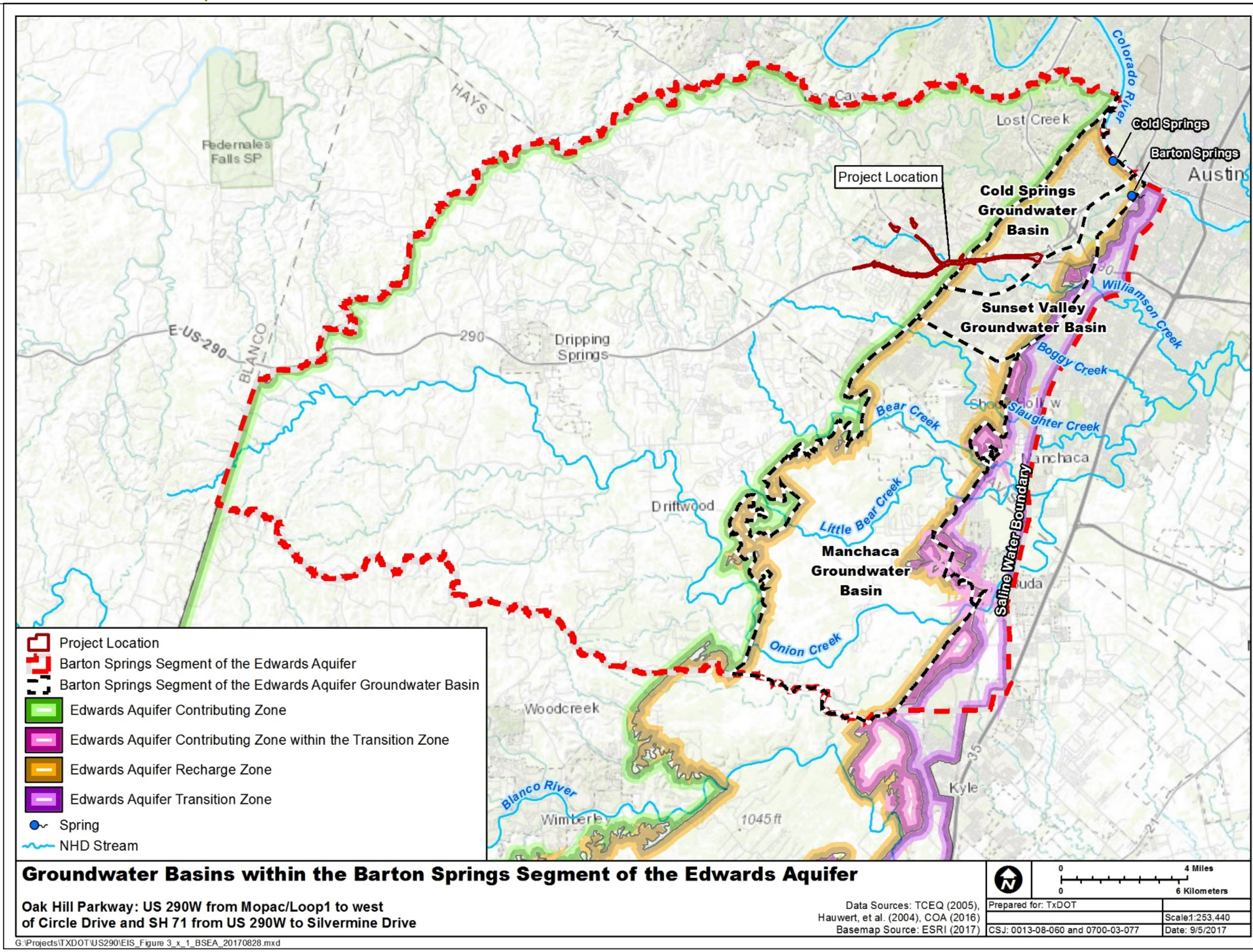

Figure 4-11. Groundwater basins within the Barton Springs segment of the Edwards Aquifer.

4.9.1.2 Groundwater Recharge and Discharge

The project area is located in a semi-arid environment with average annual rainfall of about 33 inches (National Weather Service, 2006). Evaporation removes much of this water prior to recharging the aquifer, and the remaining water that originated as precipitation is divided between runoff and recharge to the aquifer (Slade et al., 1986). Water in stream channels may percolate through the stream substrate or flow through macropores associated with karst features, faults, and joints and recharge to the underlying aquifer (Slade et al., 1986). Recharge in upland areas may occur at caves, sinkholes, faults, fractures, and other permeable features that allow water to percolate downward and enter the aquifer (USDA, 1974; TCEQ, 2008).

Groundwater discharge from the Edwards Aquifer is primarily through seeps, springs, or pumped wells. According to well data within the OHP Project area, groundwater depth is variable throughout the OHP Project corridor. Well data suggests that the aquifer depth ranges from approximately 35 to 265 feet below the ground surface throughout the OHP Project area (**Table 4-21**) (Texas Water Development Board [TWDB], 2016a). The Barton Springs segment of the Edwards Aquifer is approximately 155 square miles (BSEACD, 2003). Three groundwater basins have been delineated within this segment: Cold Springs, Sunset Valley, and the Manchaca groundwater basins (**Figure 4-11**). A portion of the OHP Project area is located within the Cold Springs groundwater basin. Several studies have been performed in the Barton Springs segment of the Edwards Aquifer to identify flow paths and rates of flow through the aquifer from these different basins. In general, dye trace studies have concluded that most groundwater within this segment discharges at Barton Springs, located approximately 4.3 miles northeast of the eastern terminus of the project area (BSEACD, 2010; Smith et al., 2005). However, some studies indicate that approximately 12 square miles of the aquifer discharges to Cold Springs (Hauwert, 2009, 2015), while others suggest that the Cold Springs discharge from this area occurs only during high flow events (Slade, 2014). Hauwert (2009) reported that two sites on Williamson Creek located downstream closer to the confluence with Onion Creek transmitted dye to Barton Springs instead of to the Cold Springs Complex. These studies document that within the Recharge Zone, Cold Springs is hydraulically linked to surface water recharge from the upper portions of Williamson Creek (Hauwert, 2009, 2015), but lower reaches of this creek are also connected to flow paths discharging at Barton Springs. It is likely that the discharge from both Cold Springs and Barton Springs is highly correlated with groundwater levels; to date, all dye trace studies for the Barton Springs segment represent point injections into recharge features and none have studied stream reaches or varying flow conditions at Barton Springs (Slade, 2014).

Table 4-21. Water Wells within 500 feet of the Project Area

Well Number	Aquifer	Primary Use	Water Depth (ft.)	Date of Sample
5841903	Trinity	Domestic	130	1969
5849310	Trinity	Unused	195	1962
5849316	Trinity	Domestic	240	1980
5849323	Unassigned	Unknown	N/A	N/A
5850103	Edwards	Domestic	35	1947
5850104	Edwards	Unused	219	1946
5850105	Edwards	Unused	145	1978
5850115	Trinity	Domestic	142	1970
5850123	Edwards	Public Supply	157	2003
5850129	Trinity	Irrigation	265	2004
5850130	Trinity	Irrigation	265	2004

Source: TWDB, 2016b

Approximately 85 percent of recharge to the Edwards Aquifer comes from six streams located within the Recharge Zone (Slade et al., 1986). Of these, Williamson Creek, its tributaries, and Devil's Pen Creek (a tributary to Slaughter Creek) occur within the OHP Project area. Recharge from the eastern portions of the project area has been associated with the Cold Springs flow route through the aquifer, which has been shown to supply water to Cold Springs and other unidentified springs on the Colorado River (Hauwert, 2009, 2015). Flow paths from downstream of the OHP Project area are located within the Sunset Valley groundwater basin and have mapped flow paths that lead to the Upper Barton and Parthenia (Main) Springs (Hauwert, 2009, 2015). Dye trace studies have shown that potential pollutants in the upper portions of Williamson Creek can reach Cold Springs (through groundwater paths) in about eight days and can reach Barton Springs from the lower reaches in as little as 30 hours under high flow conditions (Hauwert, 2009, 2015).

4.9.1.3 Groundwater Quality

The Barton Springs segment and contributing watersheds are experiencing rapid population growth which has resulted in development and increased urbanization across southwestern Travis County. According to the 2015 COA Environmental Integrity Index (EII), from 2003 to 2013 the contributing watersheds that are relevant to the OHP Project have experienced estimated increases in impervious cover of approximately 90.5 percent (Williamson Creek), 110 percent (Barton Creek), and 115 percent (Slaughter Creek). Sung et al. (2013) estimated that almost 1,400 acres of new impervious cover had been added to the Williamson Creek watershed from 1991 to 2008. Urbanization and the associated increase of impervious cover can increase stormwater runoff, which leads to the degradation of water quality by increasing anthropogenic sources of contaminants entering surface streams and groundwater conduits.

The water quality of the Barton Springs segment and its associated watersheds has been widely studied since the 1980s and was sampled for constituents, such as nitrates, as early as the 1930s (Turner, 2009; Herrington, 2003; Mahler, Garner, et al., 2006; Mahler, Musgrove, Herrington, et al., 2011; Mahler, Musgrove, Sample, et al., 2011). Barton Springs has been the focal point for much of this research since it is an iconic Austin recreation spot, provides part of the COA municipal water supply, and supports habitat for two federally listed salamanders (Slade et al., 1996; Mahler, Musgrove, Sample, et al., 2011). In addition, a portion of the Barton Springs segment is designated as a Sole Source Aquifer by the EPA, providing drinking water for approximately 60,000 people; its main discharge site is the Barton Springs Complex (Hauwert, 2009; COA 2013). For these reasons, there is interest in long-term monitoring efforts to document water quality conditions in order to measure the effects of urbanization over time.

Most of these studies measure a suite of water quality constituents such as dissolved oxygen, conductivity, pH, nitrogen, phosphorus, TSS, turbidity, and bacteria levels. Several studies have focused specifically on urban runoff constituents like atrazine (herbicides), chloroform (drinking water purification substance), and heavy metals such as zinc (Mahler, Musgrove, Sample, et al., 2011; COA 2014). Vehicle tires are the primary sources of zinc, which can be a significant component of highway runoff (Councell, et al., 2004). A recent report by Barrett (2016) evaluated the results of over 20 years of water quality data, including roadway runoff constituents (TSS and zinc), at Barton Springs. Barrett's report also examined the effectiveness of typical BMPs that are frequently used to treat stormwater runoff under COA's regulations and the TCEQ Edwards Aquifer Rules. He concluded that these BMPs are successful at removing pollutants from highway runoff, and he cited the findings of historical water quality data collected by the COA and the USGS at Barton Springs. Of particular importance to highway runoff are TSS, zinc, and copper, all of which have been stable or decreasing over the last 20 years despite the increased urbanization over the Barton Springs Zone (Barrett, 2016).

Several water quality constituents (nitrate, dissolved oxygen, sulfate, calcium, strontium, etc.) studied in Barrett's report were found to have worsened over the same period (Herrington and Heirs, 2010; Barrett, 2016). The increase in these constituents is explained in detail by Barrett (2016). Briefly, the increase in nitrates is likely associated with an increase in septic or wastewater systems throughout the Barton Springs Zone (Mahler, Musgrove, Herrington, et al. 2011; Barrett, 2016). The increases in many of the other constituents can be explained as the result of their natural occurrences in the aquifer and by the increased water supply demands, which can cause saline water from the eastern boundary of the Edwards Aquifer to move west and increase its discharge at Barton Springs (Mahler et al., 2006). This saline water line (also known as the "bad water line") is well documented as the cause of increases in the concentrations of sulfate, fluoride, sodium, chloride, strontium, and other minerals, and it can discharge at Barton Springs under certain conditions (Barrett, 2016). Based on Barrett's analysis, none of the water quality data analyzed for Barton Springs indicated any degradation due to stormwater runoff or an increase in impervious cover.

Barrett's (2016) report also focused on the effectiveness of various BMPs for stormwater runoff within the Barton Springs Zone. He concluded that, based on the water quality analysis of the constituents that are typically found in stormwater or highway runoff, the TCEQ and COA's BMP standards are effective at preventing degradation to water quality by matching or improving on background water quality parameters (Barrett, 2016).

4.9.1.4 Groundwater Quantity

The Texas Water Development Board (TWDB) recognizes 9 major aquifers and 21 minor aquifers that are a critical source of water for Texas; these sources provide approximately 62 percent of the 13.7 million acre-feet of water used across the state in 2014 (TWDB, 2016b). Groundwater levels in all the major and minor aquifers of Texas have declined since 1900 and have ranged from less than 50 feet to more than 1,000 feet (TWDB, 2016b). The Trinity aquifer, surrounding the Dallas and Waco areas, have witnessed the greatest water-level declines, whereas the Edwards aquifer has declined steadily over time but has episodically reversed this trend during major storm events when recharge exceeds discharge (TWDB, 2016b).

The Edwards and Trinity are considered tributary aquifers, which means they contribute to surface water flow through groundwater discharge. The amount of water stored in the aquifers is dependent on the relationship between climatic conditions and anthropogenic factors, such as well pumping and urbanization. A study by Barrett and Charbeneau (1996) investigated the effects of urban development on aquifer recharge and spring discharge. They found that although development reduced the amount of recharge to the aquifer during periods of direct runoff, the increase in impervious cover also resulted in more recharge during dry periods through concentrated flow routes, so that the average spring discharge remained unchanged (Barrett and Charbeneau, 1996).

Springflow discharging from Barton Springs is often used to evaluate the overall water levels of the Barton Springs segment of the Edwards Aquifer and is closely monitored by a number of agencies. The long-term average springflow at Barton Springs is 53 cubic feet per second (cfs) (Scanlon et al., 2001; Hauwert, 2009). Fluctuations in water level in the Barton Springs segment of the Edwards Aquifer represent changes in storage due to hydrologic stresses (Hunt and Smith, 2006). These fluctuations are due to a combination of seasonal and long-term (months to years) climatic changes that influence recharge via precipitation and anthropogenic changes in recharge and discharge rates (Hunt and Smith, 2006; Mahler et al., 2006). Water levels are generally lowest during extended periods of drought (Brune and Duffin, 1983). During the 2011 drought, the Austin area received only 33 percent of its average annual precipitation total, and diminished streamflow led to reduced recharge, lowering water levels in the aquifer and decreasing springflow at Barton Springs to Critical Stage Drought levels (Hunt, Smith, and Nauwert, 2012).

Recharge and discharge rates to the aquifer are influenced by a variety of anthropogenic factors. Pumpage removes water from the aquifer and can decrease discharge rates at springs, while recharge may be decreased by (1) increasing pumpage capturing groundwater upstream of contributing streams; (2) increasing temperatures and evapotranspiration rates, thereby reducing recharge; and (3) land-use practices that increase rates of evapotranspiration (Hunt, Smith, Slade, et al. 2012). In 1983, Brune and Duffin found that groundwater discharge (the sum of springflow and groundwater pumpage) was approximately equal to average annual recharge. However, more recent studies performed by the BSEACD have demonstrated the need for a reduction in pumpage from the Barton Springs segment of the Edwards Aquifer during periods of extreme drought to protect water wells from going dry and to maintain the quantity and quality of flow at Barton Springs (Hunt and Smith, 2006).

The contribution of recharge to spring discharge has been the subject of numerous studies. Mahler et al. (2006) reported that recharge water contributed from 0 to 55 percent of spring discharge during non-stormflow conditions, while Mahler and others (Mahler, Musgrove, Sample, et al., 2011) found that stream recharge contributed about 80 percent of Barton Springs discharge during a wetter-than-normal period. Groundwater flow rates are correlated to springflow rates and vary under differing climatic conditions (BSEACD, 2003).

A review of historical precipitation and hydrological data from Central Texas suggests that a change to a wetter climate has occurred since the 1960s (Hunt, Smith, Slade, et al., 2012). This shift has correlated to an increase in streamflows and springflows at Barton Creek during the past 57 years, indicating increased water within the Edwards Aquifer over this time period (Hunt, Smith, Slade, et al., 2012; TWDB, 2017). At the same time, base flow, which is the portion of stream flow that is not runoff and results from deep subsurface flow and delayed shallow subsurface flow, has decreased, and variation in flow rates has increased. This balance has resulted in relatively little change to total discharge at Barton Springs over time (Hunt, Smith, Slade, et al., 2012). Moreover, base flow declines are directly related to increased pumping from the aquifer, and pumping from the Barton Springs segment has increased dramatically in recent years, from less than 2,000 acre-feet per year in 1970 to approximately 5,700 acre-feet per year in the mid-2000s (Brune and Duffin, 1983; Hunt, Smith, Slade, et al., 2012). The Trinity Aquifer does not seem to have the same response to the increased precipitation as the Edwards, which is reflected in its declining groundwater levels despite the wetter climate (Hunt, Smith, Slade, et al., 2012).

Future water use is difficult to project because of unpredictable weather conditions and the potential for alternative water supply scenarios. However, it is projected that water levels within the aquifers may decline in response to intensification of future pumpage and potential future drought conditions associated with a changing climate (Scanlon et al., 2001).

4.9.1.5 Environmental Consequences

Groundwater Quality

Build Alternatives

Potential impacts on water quality related to roadway construction and operation can quickly translate to the aquifer and springflow environments. If contaminants, such as heavy metals, oil, nutrients, or pesticides, are mobilized by stormwater, they could flow into Williamson Creek or downstream to Slaughter Creek via tributaries and enter the aquifer through faults, fractures, or other unidentified recharge features. Although the proposed OHP Project area does not occur within the mapped subsurface drainage basin for any caves, several sensitive recharge features were noted during the GA in the vicinity of Williamson Creek (**Section 4.4**). Without appropriate BMP use, sediment-laden water may enter recharge features via overland flow or the stream bed and could bring contaminants into aquifer and spring outflow environments. Studies have shown that water in the aquifer may move at rates between 2.3 and 7.4 miles per day (Hunt, et al., 2004), and increased storm flow in creeks in the Recharge Zone has been shown to result in predictable changes in water quality parameters in Barton Springs after a short temporal lag (Hunt, et al., 2013).

The greatest possibility for groundwater impacts during the construction phase of the proposed project could occur if voids connected to the aquifer or containing groundwater are intersected during the down cutting of bedrock below the current grade or other excavation activities, such as for bridge piers. Preliminary design indicates that *Alternative A* would require the placement of approximately 167 columns and *Alternative C* would require the placement of approximately 152 columns within the Recharge Zone. Columns would reach depths between 19 and 33 feet, which would be shallower than all but one of the recorded wells near the project area.

Additionally, previously unknown caves and recharge features may be impacted by construction activities. Trenching and boring may create, uncover, or enlarge openings, changing the hydrology and atmospheric conditions of the feature. New or enlarged openings may allow for runoff to enter aquifer conduits with little to no opportunity for pollution attenuation from natural methods such as soil percolation. The accidental discovery of recharge features or other underground voids may require them to be partially or completely plugged, which could lead to their removal from the recharge matrix. A specific karst void discovery protocol would be developed for the project for all excavation phases of the proposed OHP Project.

The proposed improvements would incorporate a variety of approved practices for managing stormwater runoff during all phases of the project in order to attenuate the potential impacts to groundwater as discussed in the *Preliminary Water Quality Analysis and Design Report* (**Appendix H**). During construction, TCEQ-approved measures to reduce erosion and maintain sediment on site would be implemented and documented in the Stormwater Pollution Prevention Plan (SW3P). These measures should be effective in most conditions; however, there is a possibility that they could be overwhelmed during major rain events. Management of post-construction runoff for the proposed project would also be accomplished with permanent TCEQ-approved measures that would capture and treat the first flush. Generally, the most contaminated stormwater runoff occurs during the first flush of runoff generated during a storm event, which mobilizes particles and contaminants that have accumulated on impervious surfaces since the previous rainfall event. The proposed drainage and water quality treatment improvements would result in a net improvement in the amount of TSS and associated roadway contaminants removed from runoff leaving the OHP Project area. It is anticipated that the proposed OHP Project would result in negligible impacts to water quality. The risk would be mitigated by the incorporation of permanent TCEQ-approved BMPs that are properly maintained throughout the life of the project.

A variety of regulations are in place to protect the quality of groundwater in the Barton Springs segment of the Edwards Aquifer. The TCEQ has in place the Edwards Aquifer Protection Program which provides guidelines on complying with the Edwards Aquifer Rules, as well as Optional Enhanced Measures that may be adopted to further protect water quality (TCEQ, 2013), including wells and springs fed by the aquifer and water resources to the aquifer, and upland areas draining directly to it and surface streams. Any project located within the Recharge Zone would require the submittal of a Water Pollution Abatement Plan (WPAP) to the TCEQ. The project is located within the Edwards Aquifer Recharge Zone and Edwards Aquifer Contributing Zones as discussed in previous sections; therefore, it would require the preparation of a WPAP in compliance with the Edwards Aquifer Rules (TCEQ, 2013). According to the TxDOT-TCEQ 2013 Memorandum of Understanding (MOU), construction of either *Build Alternative* would require coordination with the TCEQ due to its location over the Edwards Aquifer and due to the project's NEPA classification as an EIS.

No Build Alternative

Under the *No Build Alternative,* stormwater runoff would continue to enter into groundwater conduits through adjacent streams and recharge features, while vehicular traffic on the roadway would continue to increase. Existing water quality controls within the project area include permeable friction course pavement, which removes approximately 18,428 pounds of TSS. Under the *No Build Alternative,* no impacts to groundwater quality resulting from construction would occur and stormwater runoff from the existing roadway would continue with limited treatment.

Groundwater Quantity

Build Alternatives

Due to the aquifer's high permeability, water levels and spring flows respond quickly to rainfall, drought, and extraction (pumping). These dynamic systems can decline rapidly in response to drought conditions but will also rebound quickly with increased precipitation (TWDB, 2016b). Groundwater quantity may be negatively impacted by the introduction of impervious cover such as roadways, parking lots, and buildings. These surfaces can limit the amount of aquifer recharge, particularly with large scale urbanization. Increased runoff due to impervious cover can divert stormwater sheet flow to discrete channels and eventually to surface streams, thus focusing surface water flow to creeks and rivers and speeding the departure of surface flow from recharge zones. Alteration of natural vegetation regimes can also reduce recharge by speeding up runoff. An increase in impervious cover could also increase the frequency of flow in creeks and stream beds where most of the recharge occurs. Sediment-laden stream water may also plug recharge features with sediment, closing off potentially important paths of aquifer recharge. In a scenario where stormwater flow is increased, infiltration is decreased, and recharge features are plugged, water levels in the Edwards Aquifer could be reduced. Low flows in Barton Springs have been associated with increased specific conductance (Mahler, et al., 2006) and decreased dissolved oxygen levels (Turner, 2009), both of which negatively affect spring-dependent biota.

Additionally, although there are no known caves or large recharge features within the OHP Project area, encroachment of impervious roadway cover on the drainage basins associated with unknown caves or recharge features could result in a decrease in water volume, resulting in potential drying of the cave environment and impacts to sensitive karst invertebrates or aquifer-dependent species utilizing those areas.

As summarized in **Table 4-22**, the proposed project would result in minimal impacts to water quantity resulting from the placement of approximately 74.0 acres of new impervious cover in an already urbanized area. The permanent BMPs would be designed to control the velocity of flow and quality of stormwater runoff leaving the project area in order to minimize any potential impacts to the recharge of groundwater over the Edwards Aquifer and would be designed to maintain similar recharge characteristics to the preexisting condition. The proposed improvements would not require the withdrawal or use of groundwater. Therefore, the proposed project would result in minimal and discountable impacts to water quantity.

Table 4-22. Project Area Acreages within Edwards Aquifer Zones and Proposed Impervious Cover Additions

Build Alternative	Recharge Zone (acres)	Contributing Zone (acres)	Addition of Impervious Cover (acres)
Alternative A	139.39	252.88	74.0
Alternative C	140.00	253.14	73.6

Source: TCEQ, 2005; Project Team, 2017

No Build Alternative

Under the *No Build Alternative*, no project-related impacts to groundwater quantity would occur.

Drinking Water Systems

Build Alternatives

The TWDB Groundwater Database lists 11 private water wells within 500 feet of the OHP Project area. **Table 4-21** shows the well numbers, well types, and recorded water depth for the listed wells. Although this well data represents a single measurement in time, it provides a reference point for the recorded water levels closest to the OHP Project area. The data suggests that the groundwater level is below the anticipated depth of impact for construction activities on this project. Total depth of the public water supply wells ranged from 0 to 300 feet below the ground surface. It should be noted that the TWDB is the most accurate listing of water wells available, but only includes wells which have been reported to TCEQ and the TWDB and does not include all water supply wells in the State of Texas. The proposed project would not require the withdrawal of water from any adjacent wells or other drinking water systems. Additionally, there are no public water supply wells or public water supply intakes within or adjacent to the OHP Project area (TCEQ, 2017). Due to the robust BMPs proposed for protection of stormwater runoff within the project area, no impacts to the quality of well water is anticipated for either *Build Alternative*.

No Build Alternative

Under the *No Build Alternative*, no project-related impacts to existing water wells or drinking water systems would occur.

Encroachment-Alteration Effects

Encroachment-alteration effects to groundwater quality could occur primarily due to increased impervious cover or removal of vegetation that results in increased runoff, erosion, and altered recharge (flow and quality) to the aquifer. Impervious cover would be directly increased by the additional travel lanes for either *Build Alternative* and the roadway infrastructure associated with those options. Impervious cover may also increase due to induced changes that result from the proposed project. Placement of the roadway could encroach on the surface or subsurface drainage areas of previously unknown adjacent karst recharge features, altering the hydrologic regimes in those features. Negligible groundwater quantity encroachment-alternation effects are anticipated as a result of the proposed project.

4.9.2 Surface Water Resources

The following sections describe the existing conditions and proposed impacts to surface water resources within the project area. This information is summarized from the OHP Project *Water Resources Technical Report* which is included as Appendix G.

4.9.2.1 Existing Conditions

Within the OHP Project area, surface water resources are closely connected to groundwater quality and quantity due to the recharge characteristics of the aquifer. For instance, in Central Texas high-intensity rainfalls tend to lead to pulses of stormwater runoff due to the abundance of clayey soils, which favor overland flow (sheet flow) over infiltration, especially in high volume rain events where soil saturation is quickly reached or where the ground surface is highly impervious (Hillel, 1982). This sheet flow quickly concentrates in creeks and may send a pulse of water directly into aquifer recharge features in the stream bed (Hunt et al., 2004). Sheet flow may also enter into upland recharge features (Cowan and Hauwert, 2013). As is the case with most aquifers dominated by karst geology, pulses of water move through underground conduits and emerge again as surface water at nearby springs and seeps. This movement can happen quite rapidly, especially at times of high flow (Hunt et al., 2004).

4.9.2.2 Watersheds

The proposed project is located within the Colorado River Basin and crosses the drainage area of three watersheds: Slaughter, Williamson, and Barton Creek (Figure 4-12). The COA Water Utility Department provides drinking water from the Colorado River and groundwater supplied from the aquifer. Contaminants in the source water may include microbes, inorganic and organic substances, pesticides and herbicides, and radioactive materials (COA, 2013). The COA Department of Watershed Protection, the Lower Colorado River Authority (LCRA), the TCEQ, and USGS, among others, monitor water quality in locations surrounding the project area. The data collected by these entities is reported in the LCRA Water Quality Index, the TCEQ *Integrated Report for Surface Water Quality*, and the COA EII, and is compiled for independent research projects. A surface water quality monitoring site occurs within the OHP Project area at the Williamson Creek/US 290 crossing. The parameters measured at this site would account for runoff in the Williamson Creek watershed located north and west of the project area. The next closest monitoring site is located at the intersection of Slaughter Creek and RM 1826, approximately 2 miles downstream of the OHP Project area. Water quality parameters that have the potential to impact sensitive species and drinking water quality include dissolved oxygen, conductivity, TSS, and point and non-point source contaminants (U.S. Department of the Interior, 2013).

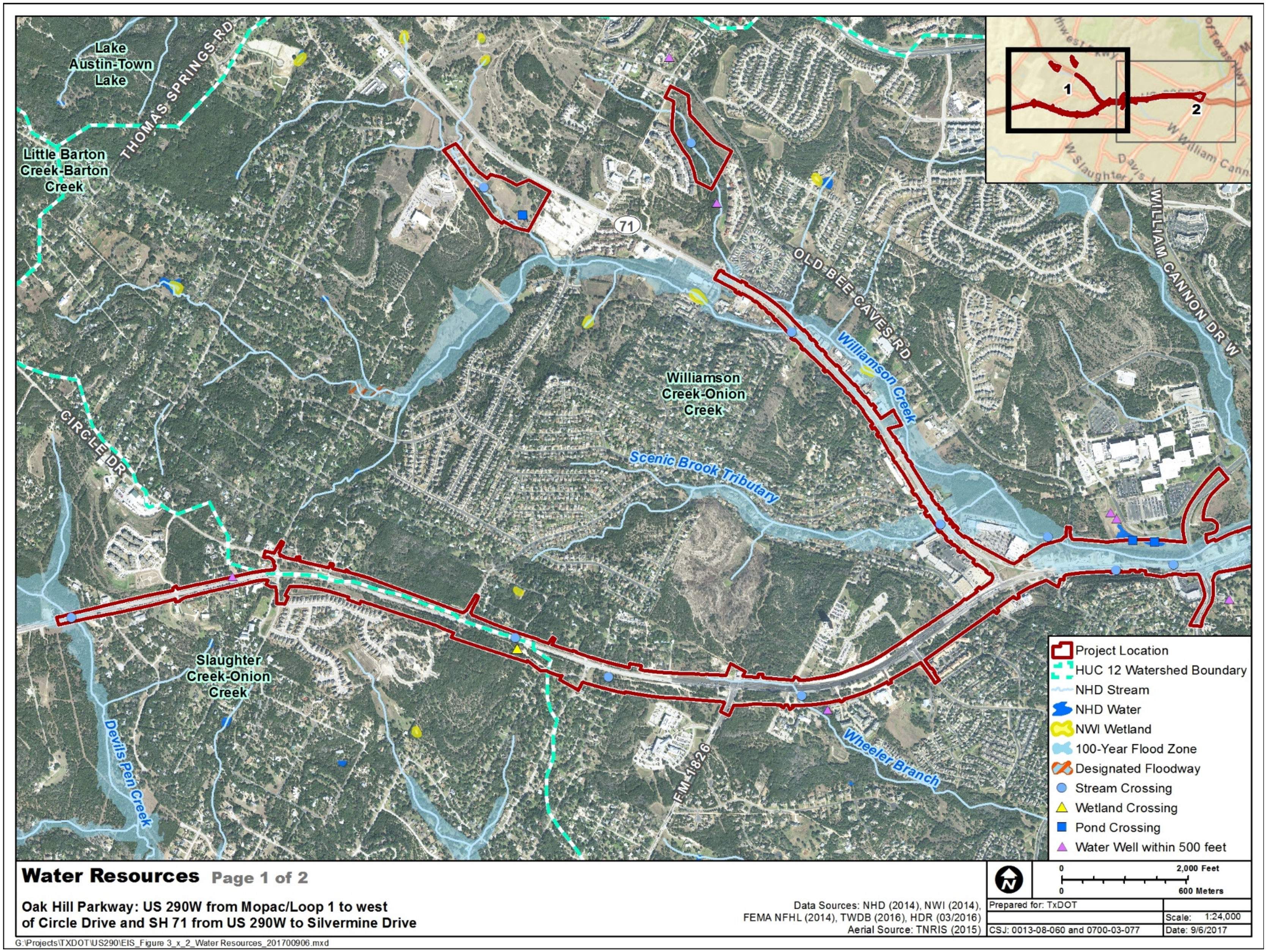

Figure 4-12a. Water resources overlain on the OHP Project area.

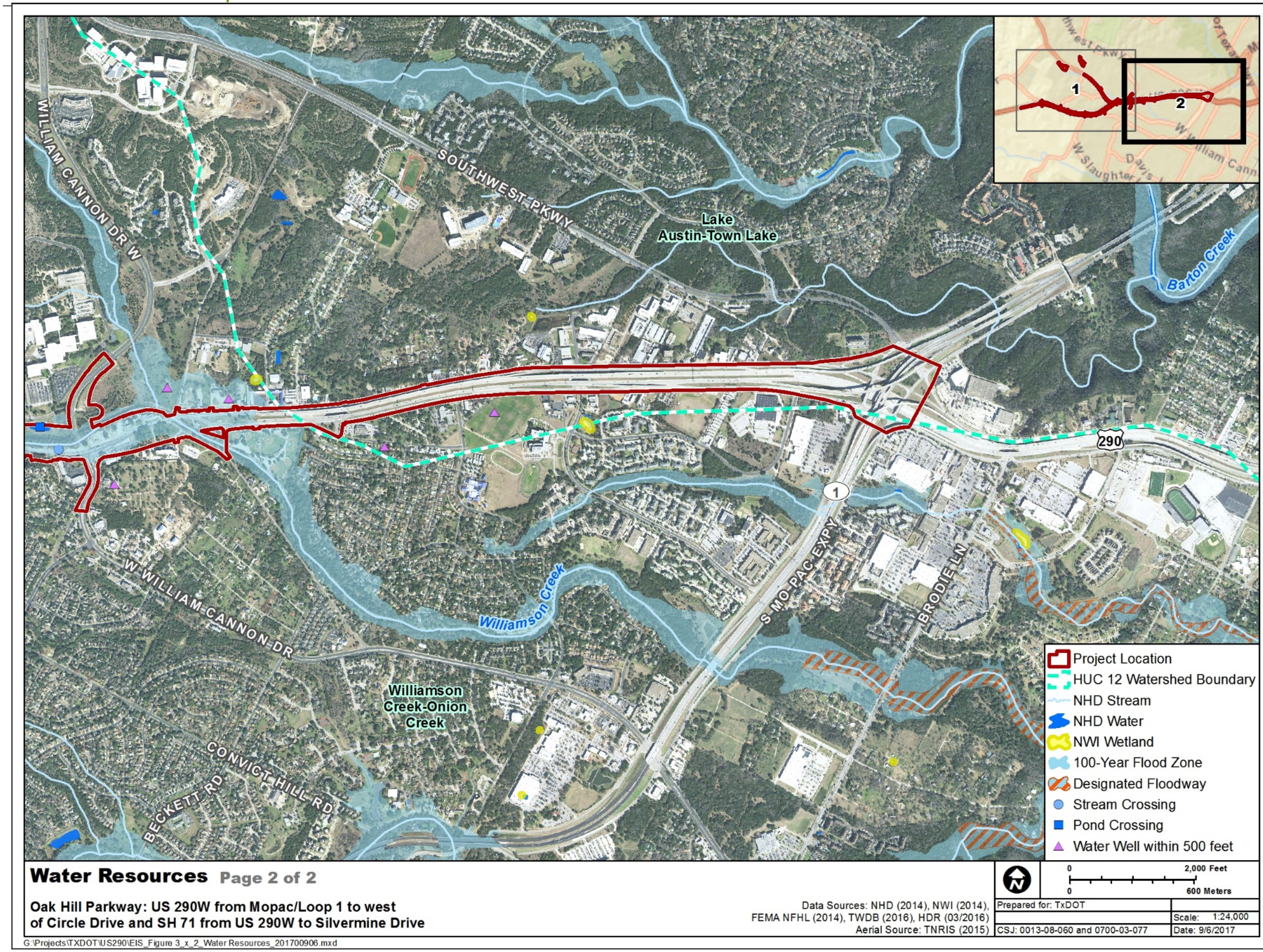

Figure 4-12b. Water resources overlain on the OHP Project area.

The COA Watershed Protection Department samples water quality parameters in 50 watersheds within the COA's planning area to compile an EII. The EII is a comprehensive biological, chemical, and physical inventory of data and is representative of current water quality in the project area. Each watershed is given an individual parameter score and assigned an overall EII score for long-term trend analysis. Data are collected for dissolved oxygen, pH, conductivity, ammonia, nitrate, ortho-phosphates, TSS, turbidity, *E. coli*, benthic macroinvertebrates, and diatoms. The scores are ranked Very Bad, Bad, Poor, Marginal, Fair, Good, Very Good, and Excellent.

The Williamson Creek watershed has a total catchment area of 30 square miles, of which 8 square miles are located within the Recharge Zone of the Edwards Aquifer. The majority of the OHP Project area is contained within the Williamson Creek watershed boundary. Onion Creek is the receiving water for this stream and is located approximately 18.75 miles downstream from the origination of Williamson Creek. Based on 2013 data presented in the COA EII Summary Factsheet for Williamson Creek:

- Impervious cover accounts for approximately 34.1 percent of the land use in the Williamson Creek watershed.
- The overall EII score for the Williamson Creek watershed was 70 (Good). Williamson Creek ranked better than 27 other watersheds in Austin.
- The water chemistry EII score for the Williamson Creek watershed was 64 (Good), which is above average as ranked by the COA.
- The sediment quality EII score for this watershed was 83 (Very Good). Polycyclic Aromatic Hydrocarbons (PAHs) are low, herbicides/pesticides are low, and metals are low.
- The aquatic life EII score for the Williamson Creek watershed was 72 (Good). The benthic macroinvertebrate community is Fair; the diatom community is Very Good.

The Slaughter Creek watershed has a total catchment area of 30.7 square miles, of which 10.7 square miles are located within the Recharge Zone (COA, 2014). Slaughter Creek is approximately 18 miles in length; Onion Creek is the receiving water for this stream. Based on 2014 data presented in the COA EII Summary Factsheet for Slaughter Creek:

- Impervious cover accounts for approximately 19.4 percent of the land use in the Slaughter Creek watershed.
- The overall EII score for the Slaughter Creek watershed was 77 (Very Good). Slaughter Creek ranked better than 39 other watersheds in Austin.
- The water chemistry EII score for the Slaughter Creek watershed was 71 (Good), which is above average as ranked by the COA.

- The sediment quality EII score for this watershed was 75 (Very Good). PAHs are low, herbicides/pesticides are low, and metals are low.
- The aquatic life EII score for Slaughter Creek watershed was 83 (Very Good). The benthic macroinvertebrate community is Very Good; the diatom community is Very Good.

The largest of the watersheds that is crossed by the OHP Project area is the Barton Creek watershed, which has a total catchment area of 108.7 square miles, of which 7.8 square miles are located within the Recharge Zone of the Edwards Aquifer (COA, 2013). Town Lake (the Colorado River) is the receiving water for this stream. Barton Creek is approximately 49.5 miles in length. Based on 2013 data presented in the COA EII Summary Factsheet for the Barton Creek watershed:

- Impervious cover accounts for approximately 8 percent of the land use in this watershed.
- The overall EII score for the Barton Creek watershed was 79 (Very Good). Barton Creek ranked better than 42 other watersheds in Austin.
- The water chemistry EII score for the Barton Creek watershed was 70 (Good), which is above average as ranked by the COA.
- The sediment quality EII score for this watershed was 75 (Very Good). PAHs are low, and metals are low.
- The aquatic life EII score for Barton Creek watershed was 86 (Very Good). The benthic macroinvertebrate community is Very Good; the diatom community is Very Good.

4.9.2.3 Jurisdictional Waters of the U.S., Including Wetlands

In accordance with the Clean Water Act (CWA [33 U.S.C. 1251 et. Seq]), Section 404, the CFR defines jurisdictional waters as all waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including their tributaries and adjacent wetlands (40 CFR 230.3). This includes streams exhibiting an Ordinary High Water Mark (OHWM), their adjacent wetlands, and other water bodies exhibiting a “significant nexus” with these waters (i.e., exerting a substantial effect on the chemical, physical, and biological integrity of those waters).

Section 404 of the CWA also defines jurisdictional wetlands as “areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” Wetlands generally include swamps, marshes, bogs, and similar areas. The USACE regulates the fill of waters of the U.S., including wetlands, and has established methodology for the delineation of wetlands. The USACE methodology utilizes vegetation, soils, and hydrologic characteristics of a site in the delineation of wetlands. Additionally, the discharge of dredged or fill material into jurisdictional waters requires CWA Section 401 water quality certification from the TCEQ, and Executive Order 11990, "Protection of Wetlands," directs federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands on federal lands.

Within the OHP Project area, US 290 is crossed by one tributary to Slaughter Creek (Devil's Pen Creek), five unnamed tributaries to Williamson Creek, Wheeler Branch, and Williamson Creek. SH 71 is crossed by Scenic Brook Tributary, one other unnamed tributary to Williamson Creek, and the main branch of Williamson Creek. The areas proposed for both of the detention ponds include tributaries to Williamson Creek. Williamson Creek is an intermittent stream within the OHP Project area; it flows to the southeast into Onion Creek and on to the Colorado River. The main branch of Slaughter Creek is a perennial water; it flows southeast into Onion Creek and on to the Colorado River. Its confluence with Onion Creek is located approximately 7 miles upstream of the Williamson Creek confluence. Tributaries to Williamson Creek and Slaughter Creek would be considered potentially jurisdictional waters of the U.S. due to their direct hydrologic connection to a traditional navigable water. Because all of the streams in the project area are tributaries to Williamson Creek or Slaughter Creek, they would also be considered potentially jurisdictional. In addition to the streams, one emergent wetland was identified within the OHP Project area. This wetland is associated with a stream crossing in the OHP Project area. Additional information regarding impacts to these resources is provided below in **Section 4.9.2.6**.

4.9.2.4 Floodplains

A floodplain is a low-lying area adjacent to a river or stream that is subject to flooding. FEMA publishes flood insurance rate maps (FIRMs) that delineate the base floodplain elevations and floodways for the major rivers and streams. The regulatory floodway indicates the corridor of effective flow area within the floodplain where, if the base flood encroaches equally on both banks in terms of flow conveyance, the base flood elevation is increased no more than 1 foot. The 100-year floodplain includes areas that would be inundated by a flood event that has a one percent chance of being equaled or exceeded in any given year.

Executive Order 11988, "Floodplain Management," requires that federal agencies avoid activities that directly or indirectly result in the development of a floodplain area. This executive order requires federal agencies to avoid, to the extent possible, the short- and long-term adverse impacts associated with occupancy development wherever there is a practicable alternative. In addition, county and other local agencies regulate development in floodplains. The project is located in Travis County, which is a participant in the National Flood Insurance Program (NFIP). If work occurs within a designated 100-year floodplain and the project may increase the base flood elevation to a level that would violate the applicable floodplain regulations, then it would require coordination with the local Floodplain Administrator. According to the FEMA FIRM Maps, the project intersects the designated 100-year floodplains associated with Williamson Creek and Devil's Pen Creek (**Figure 4-12**).

4.9.2.5 Surface Water Quality and Quantity

Section 402 of the CWA regulates the discharge of wastewater or storm water from municipal, industrial, and commercial facilities and construction sites. Permission for such discharges must be obtained from the EPA through a National Pollutant Discharge Elimination System (NPDES) permit. In September 1998, the TCEQ assumed responsibility for administering the NPDES program in Texas. The TCEQ, through the Texas Pollutant Discharge Elimination System (TPDES), now has regulatory authority over discharges of pollutants into Texas surface waters.

Under the TCEQ Chapter 307 rules, all surface waters of the state are classified as unique segments in the Texas Surface Water Quality Standards (TSWQS). The TSWQS establish goals for surface water quality throughout the state and identify the criteria for determining a waterbody's appropriate use (e.g., aquatic life, public water supply, or recreation) or level of impairment based on water quality criteria. For the purposes of monitoring water quality, the TCEQ has divided the major water bodies within the Colorado River Basin into 34 discrete segments. Williamson Creek, an unclassified water body, drains in a southeastern direction into Onion Creek, which intersects with the Colorado River below Town Lake and eventually drains into the Gulf of Mexico. Devil's Pen Creek is an ephemeral waterway at the western end of the project area and it does not have a segment ID; however, it drains southward into Slaughter Creek, which terminates at its confluence with Onion Creek.

The Williamson Creek segments were listed in the *2014 Texas Integrated Report of Surface Water Quality* as meeting all applicable water quality standards (TCEQ, 2015a). Two segments of Onion Creek located upstream of the Williamson Creek confluence were listed as impaired in 2014 by TCEQ but would not be impacted by the proposed project. According to the 2014 *Texas Water Quality Inventory, Water Body Assessments by Basin* report (TCEQ, 2015b), Williamson Creek includes designated uses for aquatic life use and general use, while Onion Creek includes aquatic life use, recreation use, general use, fish consumption use, and public water supply use. Williamson Creek and Onion Creek were listed as including no water quality concerns and were considered to be fully supporting of their designated uses. Onion Creek does not have a EPA-approved total maximum daily load (TMDL) or TCEQ-approved implementation plan.

Devil's Pen Creek is an ephemeral creek at the western end of the project intersecting US 290; it is a tributary to Slaughter Creek, which is located 0.2 mile south of the OHP Project area. Slaughter Creek has been listed since 2002 for an impaired macrobenthic community from the confluence with Onion Creek to above US 290. Slaughter Creek includes designated uses for aquatic life, recreation, and general use (TCEQ, 2015b). As of November 2015, Slaughter Creek does not have an EPA-approved TMDL standard or a TCEQ-approved implementation plan established to address these issues. The TCEQ 2014 303(d) list was utilized in this assessment (TCEQ 2015a).

4.9.2.6 Environmental Consequences

Jurisdictional Waters of the U.S., Including Wetlands

Build Alternatives

Investigations to identify the general types of wetlands and other potential waters of the U.S. that occur in the OHP Project corridor included a review of background information such as aerial photography, topographic maps, soil maps, USFWS NWI maps, and FEMA floodplain maps. Field reconnaissance was conducted to preliminarily verify the presence of jurisdictional areas in July 2015. The acreage of each potentially jurisdictional water body within the OHP Project area for each *Build Alternative* is shown in **Table 4-23** below. These acreages do not reflect actual impacts but presence within the project area. Exact acreages of impact would be determined during design if a Build Alternative is selected. Field verification was restricted to areas where right-of-entry was granted; detention pond locations were not included in this assessment due to lack of right-of-entry.

Table 4-23. Potential Impacts to Water Bodies within the OHP Project Area

Aquatic Resource Type	Description	OHWM (ft.)	Acreage Within Alternative A	Acreage Within Alternative C
Wetland 1	Headwaters of Tributary to Scenic Brook Tributary	undet.	0.03	0.03
Stream 1	Unnamed Tributary to Williamson Creek	3	0.01	0.01
Stream 2	Unnamed Tributary to Williamson Creek	2	0.04	0.04
Stream 3	Ephemeral Stream Wheeler Branch	10	0.45	0.45
Stream 4	Ephemeral Scenic Brook Tributary to Williamson Creek	20	0.08	0.85
Stream 5	Perennial Stream Headwaters of Williamson Creek at SH 71 bridge	5	0.03	0.03
Stream 6	Williamson Creek	25	2.27	2.17
Stream 7	Unnamed Tributary to Williamson Creek	5	0.18	0.18
Stream 8	Unnamed Tributary to Williamson Creek	4	0.02	0.02
Stream 9	Devil's Pen Creek*	undet.	undet.	undet.
Stream 10	Unnamed Tributary to Williamson Creek*	undet.	undet.	undet.
Stream 11	Unnamed Tributary to Williamson Creek*	undet.	undet.	undet.
Pond 1	Detention Pond*	n/a	n/a	0.06
Pond 2	Detention Pond*	n/a	n/a	0.61
Stock Pond 1	Stock Pond*	n/a	0.33	0.33

Aquatic Resource Type	Description	OHWM (ft.)	Acreage Within Alternative A	Acreage Within Alternative C
Total			3.44	4.78

Source: USFWS, 2017; USGS, 2017; Project Team, 2017.
*Right-of-entry was not granted for these areas; estimates were calculated from desktop analysis.

Typically for linear transportation projects, if less than 0.5 acres of fill is proposed into a single and complete crossing, then impacts to any waters of the U.S., including wetlands, would be authorized under a Nationwide Permit 14 (NWP 14); impacts greater than 0.5 acre would require an Individual Permit. For a NWP 14, impacts which equal or exceed 0.1 acre or discharge into a wetland would require a pre-construction notification. Based on current design concepts for the OHP Project, each crossing of Williamson Creek, its tributaries, and Devil's Pen Creek are anticipated to span the OHWM, resulting in minimal permanent impacts to these water bodies.

Temporary construction impacts would be minimal due to the proposed use of BMPs or activities (e.g., work platforms, coffer dams, temporary access roads) that are designed to minimize impacts to existing waters and wetlands.

No Build Alternative

Under the *No Build Alternative*, no project-related direct impacts to waters of the U.S. or other water resources would occur. Existing impacts to water resources would continue, such as pollution from stormwater runoff and impacts from maintenance activities within the OHP Project area.

Floodplains

Build Alternatives

There are 71.77 acres of FEMA-mapped floodplains within the OHP Project area. Areas mapped as Zone A or AE are subject to inundation by the 1-percent-annual-chance flood event. *Alternative A* includes 69.42 acres and *Alternative C* includes 69.66 acres of Zone A or AE connected to Williamson Creek within the OHP Project area. Therefore, the *Alternative C* alignment would cross an additional 0.24 acres of floodplains compared to the *Alternative A* alignment. Both alternatives include 1.3 acres of floodplain at Devil's Pen Creek. Neither *Build Alternative* would provide new access across the floodplains of Williamson Creek or Devil's Pen Creek and neither *Build Alternative* would support incompatible development within any floodplain. Although the existing US 290/SH 71 roadways represent a current encroachment upon the 100-year floodplains of these two creeks, the proposed *Build Alternatives* would avoid significant floodplain encroachments, would avoid actions that adversely affect the base floodplains, and would be compatible with the NFIP and FEMA programs; therefore, either *Build Alternative* would meet the requirements of a practicable alternative under Executive Order 11988.

In addition to the impacts discussed above, the existing concrete bridges at Old Bee Cave Road, William Cannon Drive, and US 290 would be removed and rebuilt under both *Build*

Alternatives. It is anticipated that approximately 563, 1,597, and 996 cubic yards (CY) of concrete would be removed from the 25-year floodplain at these locations. The new crossings would include construction of bridges utilizing 10-by-10-foot concrete columns totaling 222 CY. The net result of the bridge removal/reconstruction would be an approximately 2,933 CY reduction of concrete within the 25-year floodplain of Williamson Creek. When coupled with the proposed upstream detention ponds, the bridge crossing improvements are anticipated to have a positive effect on downstream flooding. For flood events below a 10-year flood, there would be no overland flow outside the banks of Williamson Creek, and for flood events at the level of a 10-year flood or higher, overflow from the Williamson Creek to Barton Creek watershed would occur. However, under either *Build Alternative*, 10-year or higher flood levels at the overflow point would be reduced by approximately 0.5 feet from the existing conditions (H&H Resources, 2017).

Impacts to floodplains in the project area would be minimized by using BMPs during both construction and operation of the proposed project. Over 5 acres of earth would be disturbed as a result of either *Build Alternative*, which would require preparation of a SW3P for the project. Stormwater runoff would be addressed through compliance with the TPDES and Edwards Aquifer Protection Program. It is anticipated that bridge support structures (e.g., piers and abutments) and culverts could be designed to avoid causing an increase in the base flood elevation that would violate applicable floodplain regulations. Coordination with the local floodplain administrator would be required. A conditional letter of map revision will be required and will be submitted to FEMA once final design is complete. Additional information regarding construction within the floodplain of Williamson Creek, including the hydraulics design associated with stream crossings in the project area, is detailed in the *Hydrology and Hydraulics Study US 290/SH71 Oakhill Parkway Project Travis County*, included as **Appendix I**.

No Build Alternative

Under the *No Build Alternative*, no project-related direct impacts to floodplains would occur. The *No Build Alternative* would not benefit from the removal of concrete from the Williamson Creek channel at Old Bee Cave Road, William Cannon Drive, or US 290, and there would not be a reduction in overland flow during a 10-year or higher flood event.

Surface Water Quality and Quantity

A summary of potential impacts resulting from the construction and operation of the OHP Project is provided below. A more detailed discussion of the potential impacts, as well as the project-specific minimization and mitigation measures, is provided in the *Oak Hill Parkway Water Resources Technical Report* and the *Preliminary Water Quality Analysis and Design Report* included as **Appendices G and H**, respectively. A discussion of the water quality impacts as they pertain to federally listed species is included in **Section 4.10.3.2**.

Build Alternatives

During the construction phase, site preparation activities such as grading, excavating, trenching, boring, and clearing vegetation result in loosened topsoil. In addition to these activities, new materials (e.g., rocks and soils) are often transported to construction sites to be used as fill materials; therefore, construction sites may create extensive areas that are susceptible to erosion. Although these exposed areas are temporary, they may be highly erodible until final revegetation of the right-of-way has occurred. Erosive forces associated with stormwater come from rain that falls directly onto the OHP Project area and from overland flow that originates up-gradient and crosses the project site. Once eroded, soil would be transported down-gradient and could be deposited in low spots, streams, drainage areas, or in an aquifer recharge feature (such as a cave or sink). Dye trace studies have shown that potential pollutants in lower Williamson Creek can reach Barton Springs (through groundwater paths) in as little as 30 hours under high flow conditions (Hauwert, 2009, 2015).

The erosion and sedimentation of soil and other particles from construction sites can have direct negative impacts on water quality. When introduced into aquatic environments, both the particles and any pollutants adhering to them can impact the basic functions of aquatic species. Under excessive sedimentation, essential habitat and aquatic plants may also be directly shaded by particles suspended in the water column or be covered completely. Sediment may be indirectly associated with other impacts as well, such as by acting as a vector for pollutants or contributing to the degradation of a variety of water quality indicators. Sediment may become contaminated with hydrophobic pollutants such as pesticide residues and heavy metals, which adsorb onto certain soil particles. This contaminated sediment, when deposited, may act as a reservoir of toxic compounds and contribute to bio-concentration of toxins in aquatic plants and animals (Barrett et al., 1995b). Oil and grease residues and dissolved nutrients may be associated with sediment particles as well. The use of heavy machinery, along with the fluids, fuels, and lubricants necessary for its operation, combined with the effects of frictional wear on metal parts, increases the likelihood of soil contamination by oil, grease, and metals on construction sites. By-products from fuel combustion that become temporarily suspended in the air may also contaminate soil through atmospheric deposition during rain events.

Because of the direct and indirect impacts associated with solids entrained in a waterbody, the TSS in a sample of water is measured as an important indicator of water quality. TSS is the fraction of total solids present in a water sample that are not dissolved but are smaller than 2 micrometers in size. TSS reduction is often a goal in pollution mitigation because the time required for a particle to settle increases as the size of the particle decreases. A 3-micrometer silt particle will take 20.1 hours to settle 1 meter through water, while a 1.5-micrometer particle will take 79 hours to settle the same distance (TXDOT, 2013). Therefore, while the total solids in a sediment-laden water body may be primarily comprised of larger particles, measures that reduce TSS would have beneficial impacts on levels of other solids as well.

Construction-phase contamination would be prevented by adherence to environmental commitments such as temporary BMPs outlined in the SW3P and WPAP. While TSS is a principal concern during both construction and operation of roadways, the BMPs that are proposed as part of this proposed project would address other roadway-associated pollutants as well, such as heavy metals, nutrients, and hydrocarbons.

Similar to construction impacts, potential impacts to surface water quality associated with the operational phase of roadways include two broad, interrelated categories: impacts from altered hydrology and impacts from roadway-associated pollution. Hydrological changes result mainly from the increase in impervious surfaces, the alteration of natural flow patterns, and the concentration of stormwater flow. Similar to the effects of highly compacted soils, impervious surfaces decrease infiltration rates directly by preventing access to covered areas and indirectly by increasing stormflow velocity, which can lead to increased erosion and its associated impacts. Impervious surfaces associated with roadways include the road surface itself as well as curbs, concrete swales, some types of detention ponds, and other stormwater management infrastructure. Current project design indicates that approximately 74.0 and 73.6 acres of impervious cover would be added as a result of *Alternative A* and *Alternative C*, respectively.

The proposed project includes two upstream detention ponds (with a total area of 18.30 acres) and up to 17 water quality ponds to mitigate for the increased impervious cover throughout the OHP Project area. These permanent ponds would be designed to improve the quality of stormwater runoff as well as the flow characteristics (e.g., rate and velocity) of discharged stormwater, which would decrease flood potential and reduce channel scouring downstream. It is anticipated that due to the upstream detention ponds and the US 290 bridge improvements at Old Bee Cave Road, William Cannon Drive, and US 290 there would be a reduction in 10-year flood levels of 0.5 feet in Williamson Creek that would slightly reduce overland flow into the Barton Creek watershed (H&H Resources, 2017). This improvement would reduce the amount of roadway contaminants potentially reaching the Barton Creek watershed, and indirectly the Barton Springs complex, during storm events.

Roadway-associated pollution may be generated through highway maintenance, accidental spills, and vehicle use. Routine maintenance activities introduce pollutants such as pesticides, paint, and herbicides to the roadside environment. Accidental spills that range from small leaks to loss of fluids during crashes to tanker truck spills can introduce pollutants as well. Vehicle use also generates a number of pollutants. The processes that control the build-up of these pollutants and the processes that control their removal from the roadway have been well studied in an effort to address highway-associated pollution loads in receiving waters.

In a general sense, the pollution load that reaches a waterbody from a roadway is determined by the factors that contribute to its build-up on the roadway and the factors that contribute to its removal from the roadway, the latter also contributing to its transport to water bodies. Stormwater runoff is an important consideration for pollutant removal, but it is not the only contributing process. Roadside turbulence generated by natural wind patterns or from passing vehicles has a scrubbing effect on the road surface (Barrett et al., 1995a). Particles are blown from the surface of the road and deposited in areas adjacent to the traffic lanes. Other substances may be removed from the roadway by volatilization, oxidation, or other chemical degradation. Through processes like these, pollution loading tends to reach an equilibrium between rain events with dry-period processes removing a portion of the pollutant load as it is being deposited (Li and Barrett, 2008). In addition, researchers have theorized that pollutant loading to the roadway may vary with rainfall intensity (Li and Barrett, 2008).

Surface water quantity impacts may occur in association with construction and operation activities as well. Changes in vegetation coverage, addition of impervious cover, soil compaction, and soil roughness (a measure of how easily water will flow over the ground) all change infiltration rates and flow dynamics. A decrease in soil roughness and an increase in soil compaction are common on construction sites where heavy machinery travels over the same areas repeatedly. Increased soil compaction leads to decreased infiltration and, therefore, increased volumes of stormwater runoff. Increases in flow volume and velocity lead to increased flow energy which, in turn, increases water's ability to carry larger sediment loads and to scour stream channels, which further increases the overall sediment load in streams if not mitigated for appropriately within the project area.

TSS is often used as an indicator of water quality because it includes both large and small sediment particles. Most BMPs designed to improve water quality focus on TSS removal in stormwater runoff. The proposed OHP Project would strictly adhere to the TCEQ standards for BMPs over the Edwards Aquifer and would commit to at least 80 percent removal of the incremental increase in TSS resulting from the proposed project's addition of impervious cover over the Recharge Zone. A *Preliminary Water Quality Analysis and Design Report* (K. Friese & Associates, Inc. [KFA], 2017) has been prepared to address permanent water quality BMPs for the OHP Project and provides approximate locations for each measure (**Appendix H**). **Table 4-24** represents a summary of the proposed TSS removal amounts by alternative. As currently designed, the anticipated TSS removal exceeds the total removal required by the TCEQ.

Table 4-24. Proposed TSS Removal by *Build Alternative*

TSS Factors	Alternative A (Pounds)	Alternative C (Pounds)
TSS Removal Required for OHP Project Area	64,405	64,094
Existing Conditions TSS Removal	18,428	18,428
TSS Credit for Storage Area*	-4,405	-4,405
Total Required TSS Removal	78,428	78,117
Proposed Conditions TSS Removal	82,837	83,220
Proposed Minus Required TSS Removal (Overtreatment)	4,409	5,103

Source: KFA, 2017.
*In 2013, TxDOT notified the TCEQ of their removal of impervious cover in a storage location within the OHP Project area and requested that the TCEQ acknowledge this as a credit of impervious cover to this project.

Post-construction TSS levels in treated stormwater are anticipated to exceed the total TCEQ required removal by approximately 4,409 pounds under *Alternative A* and approximately 5,103 pounds under *Alternative C* (KFA, 2017). As described in **Table 4-25** and **Table 4-26** below, both *Build Alternatives* would utilize a combination of upstream stormwater detention ponds, extended detention, vegetative filter strips (VFS), bioretention, and sand filter systems to meet and exceed the TSS removal required by the TCEQ.

Table 4-25. Summary of Proposed Water Quality Control Facilities—*Alternative A*

Type	Roadway	Treatment Type	TSS Removed (Pounds)
VFS Roadway	Varies	Vegetated Filter Strip	6,505
VFS Shared-Use Path	Varies	Vegetated Filter Strip	2,421
Pond A	US 290	Bioretention	1,150
Pond B	US 290	Extended Detention	4,000
Pond C	US 290	Sand Filter System	6,501
Pond D	US 290	Sand Filter System	4,110
Pond E	US 290	Sand Filter System	5,339
Pond F	US 290	Sand Filter System	17,000
Pond G	US 290	Sand Filter System	2,581
Pond H	US 290	Sand Filter System	6,840
Pond I	US 290	Sand Filter System	9,400
Pond J	US 290	Extended Detention	3,004
Pond K	William Cannon	Bioretention	2,400
Pond L	SH 71	Sand Filter System	2,015
Pond M	SH 71	Sand Filter System	950
Pond N	SH 71	Sand Filter System	990
Pond O	SH 71	Sand Filter System	4,500
Pond P	SH 71	Bioretention	880
Pond Q	SH 71	Bioretention	2,250
Total			82,837

Source: KFA, 2017.

Table 4-26. Summary of Proposed Water Quality Control Facilities—*Alternative C*

Type	Roadway	Treatment Type	TSS Removed (Pounds)
VFS Roadway	Varies	Vegetated Filter Strip	5,864
VFS Shared-Use Path	Varies	Vegetated Filter Strip	2,946
Pond A	US 290	Bioretention	1,150
Pond B	US 290	Extended Detention	4,000
Pond C	US 290	Sand Filter System	6,501

Type	Roadway	Treatment Type	TSS Removed (Pounds)
Pond D	US 290	Sand Filter System	4,110
Pond E	US 290	Sand Filter System	5,339
Pond F	US 290	Sand Filter System	26,000
Pond H	US 290	Sand Filter System	6,750
Pond I	US 290	Bioretention	5,700
Pond J	US 290	Sand Filter System	3,200
Pond K	William Cannon	Bioretention	2,000
Pond L	SH 71	Extended Detention	1,040
Pond N	SH 71	Sand Filter System	990
Pond O	SH 71	Sand Filter System	4,500
Pond P	SH 71	Bioretention	880
Pond Q	SH 71	Bioretention	2,250
Total			83,220

Source: KFA, 2017.

In addition to stormwater runoff, hazardous materials spills are also a concern for surface water quality as they may enter features associated with the Contributing and Recharge Zones of the aquifer. A Hazardous Materials Trap (HMT) would be included as a permanent BMP under either *Build Alternative* to mitigate impacts associated with accidental spills within the OHP Project corridor.

No Build Alternative

Under the *No Build Alternative,* stormwater runoff would continue to flow into adjacent streams and recharge features, while vehicular traffic on the roadway would continue to increase. Temporary changes to water quality as a result of the construction phase of the project would not occur. However, an important change to the existing conditions under either *Build Alternative* would be the inclusion of BMPs required by the TCEQ to control the quality, quantity, and velocity of water (including roadway runoff) entering streams and recharge features with flow paths to Barton Springs. The existing US 290/SH 71 roadway infrastructure within the project area lacks an HMT and stormwater detention ponds, which are designed to mitigate the impacts from stormwater runoff associated with transportation corridors.

Additionally, under the *No Build Alternative,* there would be no reduction in flood levels in Williamson Creek and the overland flow into the Barton Creek watershed would continue at current levels.

4.9.2.7 Encroachment-Alteration Effects

Waters of the U.S., Including Wetlands

Anticipated fill impacts to waters of the U.S., including wetlands, would generally be limited to the project footprint. Temporary and permanent impacts to waters of the U.S. would not disrupt any natural processes in the OHP Project area. The construction of any of the proposed alternatives would have limited encroachment-alteration effects because of the existing dense urbanization of the proposed OHP Project area and the incorporation of water quality BMPs. The USACE regulates the discharge of dredged and fill material into waters of the U.S., including wetlands, under Section 404 of the CWA. (33 U.S.C. 1251 et. Seq, Section 404); therefore, any additional development in the area surrounding the OHP Project would be subject to these regulations and subsequent minimization and mitigation measures.

Floodplains

The proposed project would result in encroachment-alteration effects within a regulatory floodplain. The proposed project would increase impermeable surfaces and have the potential to indirectly affect sediment and pollutant loading in the flood hazard areas as mapped by FEMA. However, floodplain management regulations and design standards would require that the project be designed so as not to alter base flood elevations and not cause adverse flood impacts to upstream or downstream properties.

Surface Water Quality and Quantity

Encroachment-alteration effects to water quality could occur and would primarily be due to increased impervious cover or removal of vegetation that results in increased non-point source runoff and altered recharge (flow and quality) to the aquifer, increased localized erosion, and degraded water quality downstream. Placement of the roadway could encroach on the surface or subsurface drainage areas of previously unknown adjacent karst recharge features, altering the hydrologic regimes in those features. Use of BMPs within the OHP Project area would minimize water quality effects downstream, and regulations such as the CWA's 303(d) list of impaired waters managed by the TCEQ would continue long-term monitoring of surface water quality in Travis County.

4.10 Ecological Resources

The following sections describe the regulatory authority, existing conditions, and proposed impacts to ecological resources within the project area. This information is summarized from the OHP Project *Biological Resources Technical Report*, which is included as **Appendix J**. Site visits in January, May, and June of 2016 were conducted within the existing right-of-way to assess suitability of habitat and map vegetation communities. Tree surveys were conducted within the OHP Project area in 2007, 2015, and 2017. Several parcels within the OHP Project area were not surveyed for ecological resources due to lack of right-of-entry; therefore, these areas were only assessed where they could be viewed from the public rights-of-way (**Figure 4-13**).

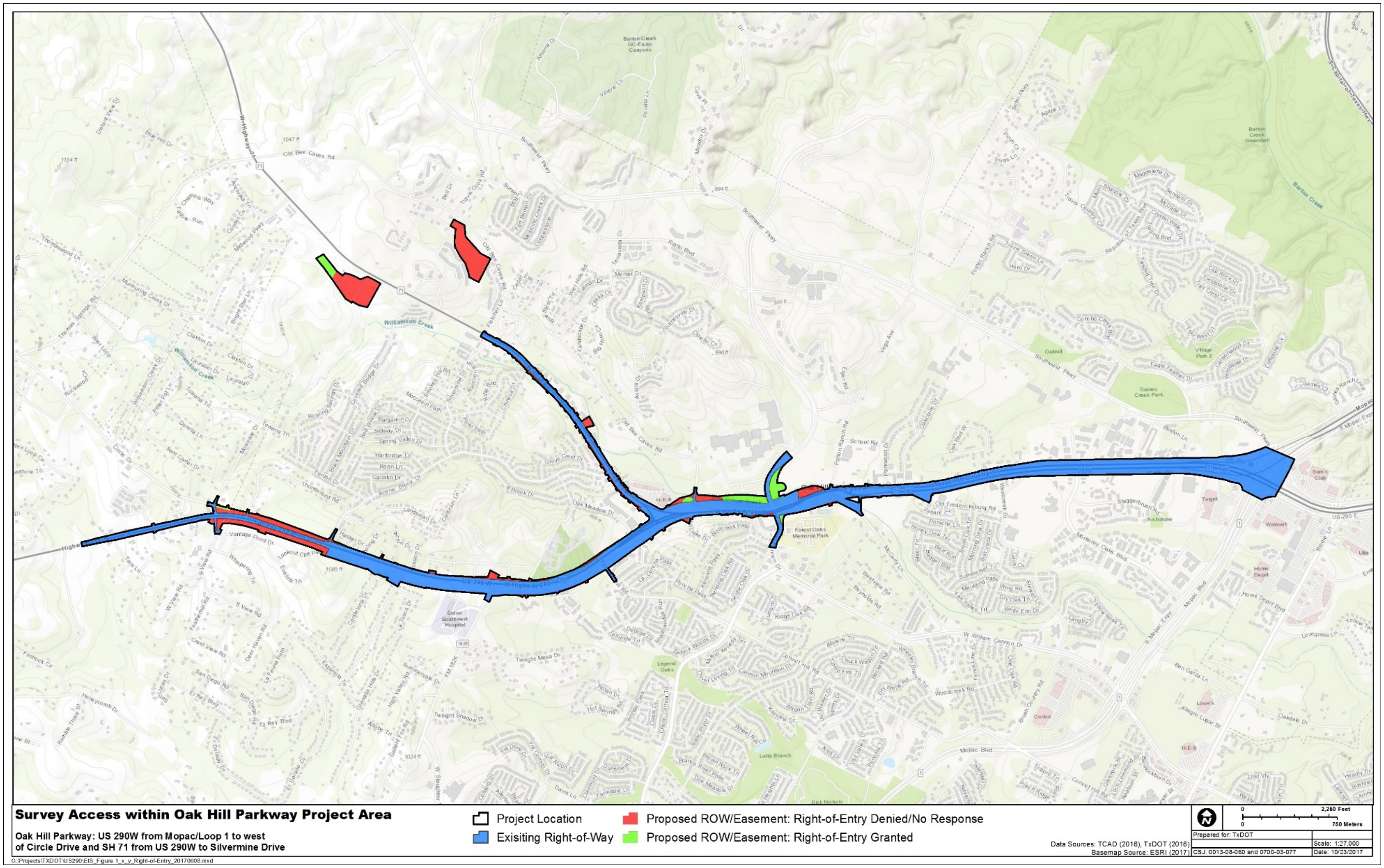

Figure 4-13. Survey access within the OHP Project area.

4.10.1 Regulatory Authority

4.10.1.1 Migratory Bird Treaty Act

Under the Migratory Bird Treaty Act (MBTA), it is unlawful "by any means or manner, to pursue, hunt, take, capture, [or] kill" any migratory birds except as permitted by regulation (16 U.S.C. 703–704). The birds listed below in **Table 4-27** were observed during the field work and comprise both resident and migratory species.

Table 4-27. Observed Avian Species

Common Name	Scientific Name	Status	MBTA Protected
Carolina Chickadee	*Poecille carolinensis*	–	Yes
Black-crested Titmouse*	*Baeolophus atricristatus*	–	Yes
Blue Jay	*Cyanocitta cristata*	–	Yes
Brown-headed Cowbird	*Molothrus ater*	–	Yes
Cave Swallow	*Petrochelidon fulva*	–	Yes
Cedar Waxwing	*Bombycilla cedrorum*	–	Yes
Cliff Swallow	*Petrichelidon pyrrhonota*	–	Yes
Common Yellowthroat	*Geothlypis trichas*	–	Yes
Eurasian Collared-Dove	*Streptopelia decaocto*	–	No
Greater Roadrunner	*Geococcyx californianus*	–	Yes
Great-tailed Grackle	*Quiscalus mexicanus*	–	Yes
House Finch	*Haemorhous mexicanus*	–	Yes
House Sparrow	*Passer domesticus*	–	No
Killdeer	*Charadrius vociferus*	–	Yes
Mourning Dove	*Zenaida macroura*	–	Yes
Northern Cardinal	*Cardinalis cardinalis*	–	Yes
Northern Mockingbird	*Mimus polyglottos*	–	Yes
Red-tailed Hawk	*Buteo jamaicensis*	–	Yes
Savannah Sparrow	*Passerculus sandwhichensis*	–	Yes
Turkey Vulture	*Cathartes aura*	–	Yes
White-winged Dove	*Zenaida asiatica*	–	Yes

Survey Date: January, May, and June, 2016
*Note that most titmice in the Austin area are considered hybrids between Black-crested and Tufted Titmouse (*Baeolophus bicolor*)
Status Codes: "–" = Species Not Considered Rare, Threatened, or Endangered

In addition to occurrences noted above, nesting swallows were noted under the SH 71 bridge over Williamson Creek and in the culverts conveying Devil's Pen Creek under US 290; several inactive bird nests were also noted within roadside vegetation adjacent to US 290 and SH 71.

Alternative A

In the event that nesting migratory birds are encountered on-site during project construction, every effort would be made to avoid protected birds, active nests, eggs, and/or young. The contractor would be advised of the potential to find nesting migratory birds within the OHP Project area and would be instructed to avoid harming these species.

All vegetation that cannot be avoided would be removed between October 1 and February 15. In addition, the contractor would be prepared to prevent migratory birds from building nests on structures between February 15 and October 1. All methods would be approved by the TxDOT Austin District Biologist well in advance of planned use.

Alternative C

The impacts to MBTA species under *Alternative C* would be expected to be similar to those described for *Alternative A* above; identical conservation measures and precautions would be utilized.

No Build Alternative

No project-specific MBTA impacts would be anticipated under the *No Build Alternative*.

4.10.1.2 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA), as amended in 1964, was enacted to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. The statute requires federal agencies to take into consideration the effect that water-related projects would have on fish and wildlife resources, take action to prevent loss or damage to these resources, and provide for the development and improvement of these resources.

Alternative A

Preliminary design indicates that improvements constructed as a result of *Alternative A* would be authorized under a NWP 14 from the USACE; therefore, separate coordination under FWCA would not be required for the proposed project. If a USACE Individual Permit becomes necessary for construction of this alternative, then additional coordination with the USFWS would need to occur for compliance under FWCA.

Alternative C

Preliminary design indicates that improvements constructed as a result of *Alternative C* would be authorized under a NWP 14 from the USACE; therefore, separate coordination under FWCA would not be required for the proposed project. If a USACE Individual Permit becomes necessary for construction of this alternative, then additional coordination with the USFWS would need to occur for compliance under FWCA.

No Build Alternative

The construction of the *No Build Alternative* would not cause modification to any natural streams or bodies of water; therefore, the FWCA would not apply.

4.10.1.3 Texas Parks and Wildlife Department Memorandum of Understanding

Transportation Code 201.60 requires TxDOT to adopt an MOU with each state agency that has a responsibility for the protection of the natural environmental or for the preservation of historic or archeological resources, and requires TxDOT and each of the agencies to adopt the memoranda and all revisions by rule. Subchapter G of the Transportation Code contains the MOU between TxDOT and the Texas Parks and Wildlife Department (TPWD), which became effective on September 1, 2013.

The MOU outlines seven triggers which, if exceeded, would require project-level coordination with TPWD. These triggers are summarized below:

1. The project is within the range of a state threatened or endangered species or Species of Greatest Conservation Need (SGCN), as identified by the TPWD county list, and there is suitable habitat for the species within the project area unless BMPs as defined in the MOU are implemented as provided by a Programmatic Agreement (PA).
2. The project may adversely impact important remnant vegetation based on the judgment of a qualified biologist or as mapped in the Texas Natural Diversity Database (TXNDD).
3. The project requires a NWP with pre-construction notification or an individual permit issued by the USACE.
4. The project includes in the TxDOT right-of-way or conservation, construction, or drainage easement more than 200 linear feet of stream channel for each single and complete crossing of one or more of the following that is not already channelized or otherwise maintained: a) channel realignment; or b) stream bed or stream bank excavation, scraping, clearing, or other permanent disturbance.
5. The project contains known isolated wetlands outside existing TxDOT right-of-way that will be directly impacted by the project.
6. The project may impact at least 0.10 acre of riparian vegetation based on the judgment of a qualified biologist or as mapped in the Ecological Mapping Systems of Texas (EMST).
7. The project disturbs habitat in an area equal to or greater than the area of disturbance indicated in the TxDOT–TPWD Threshold Table PA.

Alternative A

Alternative A required project-level coordination with TPWD. Coordination was initiated on September 1, 2017. Specifically, *Alternative A* would meet or exceed the conditions established in triggers 1, 3, 6, and 7 of the TxDOT–TPWD MOU. The impacts resulting from this alternative are discussed in **Sections 4.9.2, 4.10.2,** and **4.10.3** and in the *Biological Resources Technical Report* (**Attachment J**).

Alternative C

Alternative C required project-level coordination with TPWD. Coordination was initiated on September 1, 2017. Specifically, *Alternative C* would meet or exceed the conditions established in triggers 1, 3, 6, and 7 of the TxDOT–TPWD MOU. The impacts resulting from this alternative are discussed in **Sections 4.9.2, 4.10.2,** and **4.10.3** and in the *Biological Resources Technical Report* (**Attachment J**).

No Build Alternative

The *No Build Alternative* would not require coordination under the TxDOT–TPWD MOU.

4.10.2 Vegetation

4.10.2.1 TPWD Ecological Mapping Systems of Texas

The EMST is a land classification system that identifies vegetation communities across Texas by computer modeling and field verification (TPWD, 2010). The following EMST vegetation types were identified within the project area and are further described in TPWD's *Draft Descriptions of Systems, Mapping Subsystems, and Vegetation Types for Phase I* (Elliott, 2014): (1) Edwards Plateau: Ashe Juniper Motte and Woodland, (2) Edwards Plateau: Deciduous Oak/Evergreen Motte Woodland, (3) Edwards Plateau: Savanna Grassland, (4) Edwards Plateau: Floodplain Juniper Shrubland, (5) Edwards Plateau: Riparian Hardwood Forest, (6) Native Invasive: Mesquite Shrubland, and (7) Urban Low Intensity (**Figure 4-14**). Representative photos and species compositions for each of these vegetation communities are included in the *Biological Resources Technical Report* (**Appendix J**). These seven EMST types correspond to the "Disturbed Prairie," "Edwards Plateau Savannah, Woodland, and Shrubland," "Floodplain," "Riparian," and "Urban" habitat types which are identified in the 2013 TxDOT–TPWD MOU and Threshold PA. The MOU vegetation types have been assigned acreage thresholds which, if exceeded, would require coordination under the TxDOT–TPWD MOU as discussed below.

Figure 4-14. Observed vegetation types in the OHP Project area.

Based on site visits conducted in January, May, and June of 2016 by qualified biologists, it was determined that much of vegetation within the existing right-of-way consists of maintained grasses and forbs. Although a mixture of native hardwoods, Ashe juniper (*Juniperus ashei*), and introduced tree species persist as an overstory component adjacent to the roadways in Oak Hill, the majority of vegetation within the current transportation right-of-way fits the description of "Urban Low Intensity" habitat. Several fragmented patches of unmaintained native vegetation are located within the proposed right-of-way along US 290 and SH 71, west of Williamson Creek. Typical vegetation within these areas consists of an Ashe juniper, sugarberry (*Celtis laevigata*), chinaberry (*Melia azedarach*), American sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), Texas mountain laurel (*Sophora secundiflora*), and plateau live oak (*Quercus fusiformis*) overstory with a mixed shrub and grass understory of evergreen sumac (*Rhus sempervirens*), Texas persimmon (*Diospyros texana*), Texas pricklypear (*Opuntia engelmannii*), saw greenbriar (*Smilax bona-nox*), elbowbush (*Forestiera pubescens*), little bluestem (*Schizachyrium scoparium* var. *frequens*), mustang grape (*Vitis mustangensis*), silver bluestem (*Bothriochloa laguroides*), purple horsemint (*Mondarda citriodora*), and scattered honey mesquite (*Prosopis glandulosa*).

Alternative A

Vegetation within the project area was mapped using the EMST vegetation classifications and field verified during pedestrian surveys in 2016. No protected or rare vegetation communities, were identified within the OHP Project area during field investigation. Vegetation within the OHP Project area may be removed or disturbed during construction activities in order to accommodate additional roadway width, the shared-use path, and water treatment facilities. **Table 4-28** summarizes the extent of vegetation impacts as a result of *Alternative A*. Coordination with TPWD would be required because the thresholds for "Edwards Plateau Savannah, Woodland, and Shrubland," "Disturbed Prairie," and "Riparian" MOU Types will be exceeded.

Table 4-28. ***Alternative A*** **Impacts to Observed Vegetation Types**

Observed Vegetation Type	Corresponding MOU Type	Impacts Alternative A (acres)	PA Threshold (acres)	Threshold Exceeded?
Urban	Urban	121.46	None	N/A
Edwards Plateau Ashe Juniper, Motte, and Woodland	Edwards Plateau Savannah, Woodland, and Shrubland	25.78	3.0	Yes
Edwards Plateau Deciduous Oak/Evergreen Mottle Woodland		53.29		
Edwards Plateau: Savanna Grassland		19.03		
	MOU Total	**98.10**		
Edwards Plateau: Floodplain Ashe Juniper Shrubland	Riparian	0.06	0.1	Yes

Observed Vegetation Type	Corresponding MOU Type	Impacts Alternative A (acres)	PA Threshold (acres)	Threshold Exceeded?
Riparian		19.38		
	MOU Total	**19.44**		
Native Invasive: Mesquite Shrubland	Disturbed Prairie	3.81	3.0	Yes
	MOU Total	242.81		

Source: TxDOT-TPWD MOU, 43 TAC § 2.G (2013); Project Team, 2017

Alternative C

Impacts to vegetation as a result of *Alternative C* are anticipated to be approximately 0.88 acre less than *Alternative A*, but similar types of construction-related impacts would be expected. **Table 4-29** summarizes the extent of vegetation impacts for *Alternative C*.

Table 4-29. *Alternative C* Impacts to Observed Vegetation Types

Observed Vegetation Type	Corresponding MOU Type	Impacts Alternative C (acres)	PA Threshold (acres)	Threshold Exceeded?
Urban	Urban	123.78	None	N/A
Edwards Plateau Ashe Juniper, Motte, and Woodland	Edwards Plateau Savannah, Woodland, and Shrubland	25.78	3.0	Yes
Edwards Plateau Deciduous Oak/Evergreen Mottle Woodland		53.29		
Edwards Plateau: Savanna Grassland		19.03		
	MOU Total	**98.10**		
Edwards Plateau: Floodplain Ashe Juniper Shrubland	Riparian	0.06	0.1	Yes
Riparian		17.95		
	MOU Total	**18.01**		
Native Invasive: Mesquite Shrubland	Disturbed Prairie	3.81	3.0	Yes
Total		243.69		

Source: TxDOT-TPWD MOU, 2013; Project Team, 2017

No Build Alternative

Under the *No Build Alternative*, no vegetation impacts would be anticipated. Regular tree trimming, mowing, and herbicide treatment along the existing right-of-way would continue as a result of normal transportation operation and maintenance.

4.10.2.2 Trees

During the early public involvement stages of this project, trees were identified as an important resource by community members. Therefore, additional survey effort was expended to identify and attempt to minimize impacts to large hardwood trees within the project area. Tree surveys were conducted by two qualified survey teams within the OHP Project area where right-of-entry was granted (Atkins, 2007; Surveying and Mapping, LLC [SAM], 2015, 2017). One individual landowner provided the project team with complimentary survey data for trees as well (Powell, 2015). Each survey mapped the location, species, and size of hardwood trees within the existing and proposed right-of-way. In all, 518 native hardwood trees, including over 15 distinct species, were mapped as a result of the survey effort. The dominant species included plateau live oak (45 percent), other oaks (18 percent), and pecan trees (16 percent). The size class surveyed ranged from 10 inches in DBH to 62 inches DBH. DBH is a standard measurement of tree trunk diameter and is typically measured at 4.5 feet (alternatively 1.4 meters) above ground level. Approximately 88 percent of trees measured less than 35 inches DBH. No tree health metrics or tree conditional assessments were conducted during these initial surveys. Ashe juniper, although a dominant species in the OHP Project area, was not inventoried during the hardwood tree survey efforts.

Alternative A

Construction of this alternative would require the removal of existing trees in order to accommodate the additional roadway width and maintain safety clearance zones for vehicle traffic. **Table 4-30** summarizes the estimated impacts to large trees mapped within the existing and proposed right-of-way.

Table 4-30. *Alternative A* Tree Impacts by Species

Species Common Name	Species Scientific Name	Alternative A	
		Take	Leave
Ash	*Fraxinus sp.*	0	1
Bitternut Hickory	*Carya cordiformis*	2	1
Cedar Elm	*Ulmus crassifolia*	11	9
Cottonwood	*Populus deltoides*	1	2
Elm (non-cedar)	*Ulmus sp.*	24	21
Hackberry	*Celtis laevigata*	3	8
Live Oak	*Quercus virginiana*	130	103
Bigtooth Maple	*Acer grandidentatum*	0	1
Oak (other)	*Quercus sp.*	46	49
Pecan	*Carya illinoinensis*	51	30
Red Oak	*Quercus buckleyi*	1	0
Sycamore	*Platanus occidentalis*	8	9
Unknown	--	2	2
Western Soapberry	*Sapindus drummondii*	0	1

Species Common Name	Species Scientific Name	Alternative A	
		Take	Leave
Black Willow	*Salix nigra*	2	0
Total		281	237

Source: Atkins, 2007; Powell, 2015; SAM, 2017; tree surveys were compiled by the Project Team, 2017.
Note: Results represent trees greater than 10 inches DBH.

Although the final number of trees to be removed as a result of a *Build Alternative* would be determined once design has been finalized, preliminary results indicate that approximately 281 trees greater than 10 inches DBH would be removed in order to accommodate the OHP Project improvements under *Alternative A*. Live oaks are the dominant species across the project area and thus would experience the largest impact; nearly half of all trees removed would be live oaks. Although all native hardwoods with a DBH of greater than 10 inches were mapped within the OHP Project area, only 29 trees with a DBH greater than 35 inches would be removed under *Alternative A*.

During the early stages of this project, members of the public identified several iconic trees that held a higher community value due to their size, location, or local history (**Figure 4-15**).

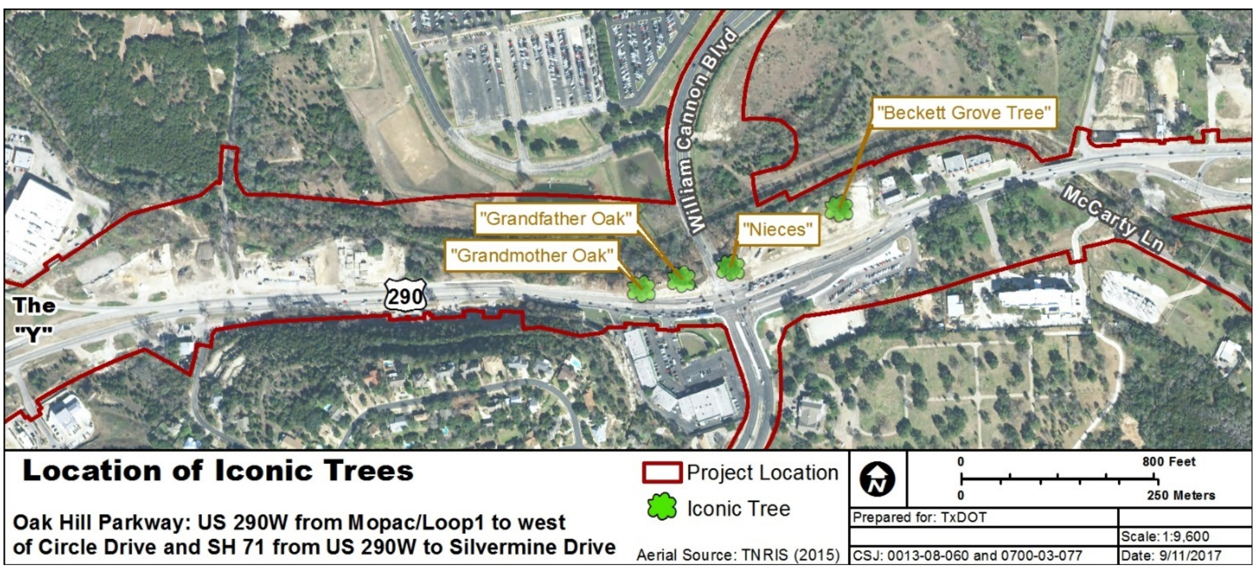

Figure 4-15. Location of iconic trees.

With that knowledge, the project team prioritized these trees for protection during project development. *Alternative A* would not remove the following iconic trees: "Beckett Grove Tree," "Grandmother Oak," "Grandfather Oak," or "the Nieces."

Alternative C

The total number of large trees removed as a result of *Alternative C* is anticipated to be identical to *Alternative A*; however, only 26 native hardwoods with a DBH of greater than

35 inches would be removed under this alternative, compared to 29 under *Alternative A* (**Table 4-31**).

Table 4-31. *Alternative C* Tree Impacts by Species

Species Common Name	Species Scientific Name	Alternative C	
		Take	Leave
Ash	*Fraxinus sp.*	0	1
Bitternut Hickory	*Carya cordiformis*	2	1
Cedar Elm	*Ulmus crassifolia*	12	8
Cottonwood	*Populus deltoides*	1	2
Elm (non-cedar)	*Ulmus sp.*	23	22
Hackberry	*Celtis laevigata*	3	8
Live Oak	*Quercus virginiana*	132	101
Bigtooth Maple	*Acer grandidentatum*	0	1
Oak (other)	*Quercus sp.*	42	53
Pecan	*Carya illinoinensis*	53	28
Red Oak	*Quercus buckleyi*	1	0
Sycamore	*Platanus occidentalis*	8	9
Unknown	--	2	2
Western Soapberry	*Sapindus drummondii*	0	1
Black Willow	*Salix nigra*	2	0
Total		281	237

Sources: Atkins, 2015; Powell, 2015; SAM, 2017; tree surveys were compiled by the Project Team, 2017.
Note: Results represent trees greater than 10 inches DBH.

Similar to *Alternative A*, *Alternative C* would not result in impacts to the following iconic trees: “Beckett Grove Tree,” “Grandmother Oak,” “Grandfather Oak,” or “the Nieces” (**Figure 4-15**).

No Build Alternative

The *No Build Alternative* would not result in any impacts to large or iconic trees within the project area other than what would be required for routine maintenance along an existing transportation corridor.

4.10.2.3 Executive Order 13112 on Invasive Species

On February 3, 1999, the President of the U.S. issued Executive Order 13112 to prevent the introduction of invasive species; provide for their control; and minimize their economic, ecological, and human health impacts.

Alternative A

In accordance with Executive Order 13112 on invasive species, native plant species would be used in landscaping and in the seed mixes where practicable following construction activities. Soil disturbance would be minimized in the right-of-way in order to minimize invasive species establishment.

Alternative C

Similar impacts to vegetation and soils would be expected for this alternative as described above. Identical commitments with respect to Executive Order 13112 would be applied for *Alternative C*.

No Build Alternative

Under the *No Build Alternative*, Executive Order 13112 would not apply.

4.10.2.4 Executive Memorandum on Beneficial Landscaping

In accordance with the Executive Memorandum of August 10, 1995, all agencies shall comply with NEPA as it relates to vegetation management and landscape practices for all federally assisted projects. The Executive Memorandum directs that where cost-effective and to the extent practicable, agencies would (1) use regionally native plants for landscaping; (2) design, use, or promote construction practices that minimize adverse effects on the natural habitat; (3) seed to prevent pollution by, among other things, reducing fertilizer and pesticide use; (4) implement water-efficient and runoff reduction practices; and (5) create demonstration projects employing these practices. Landscaping included with this project would be in compliance with the Executive Memorandum and the guidelines for environmentally and economically beneficial landscape practices by utilizing the following five practices where practicable:

- use regionally native plants for landscaping;
- design, use, or promote construction practices that minimize adverse effects on the natural habitat;
- seek to prevent pollution by reducing fertilizer and pesticide use, using integrated pest management techniques, recycling green waste, and minimizing runoff;
- implement water-efficient practices, such as the use of mulches, efficient irrigation systems, and the selecting and siting of plants in a manner that conserves water and controls soil erosion; and
- create outdoor demonstrations incorporating native plants, pollution prevention techniques, and water conservation techniques to promote awareness of the environmental and economic benefits of implementing this directive.

Alternative A

As discussed above in **Sections 4.10.2.1** and **4.10.2.2**, vegetation and tree removal impacts are expected as a result of the proposed construction activities. Approximately 281 trees and 242.8 acres of vegetation would be impacted by the construction of *Alternative A*. Landscaping enhancements were identified during the public involvement process as being a top priority for community members and would be included in the final project design. All landscaping would be in compliance with this Executive Memorandum.

Alternative C

As discussed above in **Sections 4.10.2.1** and **4.10.2.2**, vegetation and tree removal impacts are expected as a result of the proposed construction activities. Approximately 281 trees and 243.7 acres of vegetation would be impacted by the construction of *Alternative C*. Landscaping enhancements were identified during the public involvement process as being a top priority for community members and would be included in the final project design. All landscaping would be in compliance with this Executive Memorandum.

No Build Alternative

Under the *No Build Alternative*, no landscaping enhancements would be included in the project design; therefore, this Executive Memorandum would not apply.

4.10.3 Fish and Wildlife Resources

The following sections identify the species that may be impacted or affected as a result of the *Build Alternatives* within the project area. A desktop review of the TXNDD, best available scientific literature, aerial imagery, and field investigations were utilized in this assessment.

4.10.3.1 Non-Rare Fish and Wildlife

The OHP Project area is located within the Edwards Plateau ecoregion. This ecoregion provides habitat for a wide range of reptilian, mammalian, and avian species that are common to the Central Texas environment. These species, such as the eastern cottontail (*Sylvilagus floridanus*), northern raccoon (*Procyon lotor*), nine-banded armadillo (*Dasypus novemcinctus*), and white-tailed deer (*Odocoileus virginianus*), are expected to occur within the OHP Project area and adjacent undeveloped land. Terrestrial wildlife observed within the project area during field investigations include the northern raccoon, eastern cottontail, gray fox (*Urocyon cinereoargenteus*), eastern fox squirrel (*Sciurus niger*), nine-banded armadillo, coyote (*Canis latrans*), Blanchard's cricket frog (*Acris crepitans blanchardii*), and white-tailed deer.

Fish species common to rivers and streams in central Texas include Texas shiner (*Notropis amabilis*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), largemouth bass (*Micropterus*), and crappie (*Promoxis* sp.) (TPWD, 2017).

Alternative A

Potential impacts to wildlife can be attributed to the interaction of wildlife with construction machinery, the loss of wildlife habitat, habitat fragmentation, noise interference, and wildlife/vehicle collision mortalities. The impacts would occur during the construction and operation of the proposed project and would potentially result in direct impacts to fish and wildlife resources in the proposed OHP Project area. Construction of *Alternative A* would directly impact animals that reside within the path of the roadway alignment. As with the vegetation, wildlife communities would be impacted by the permanent loss of habitat.

In addition to direct, construction-related mortality or injury, wildlife populations often suffer impacts associated with displacement into adjacent habitats, which are often already at carrying capacity for that particular species. Wildlife inhabiting areas within each alternative alignment's right-of-way would need to relocate to adjacent habitats during vegetation clearing and earth-moving activities in order to survive. Heavy machinery and other construction equipment may cause mortality of wildlife species that are slow moving or species that seek cover in debris and fallen vegetation. Construction-related impacts would be short-term and would primarily occur during initial right-of-way clearing activities. Wildlife populations adjacent to the proposed OHP Project area would also be impacted by construction noise and activity that could stress them or cause them to seek refuge away from the project area. Once completed, noise and traffic activity would continue to persist, albeit at a lower level. The proposed project occurs within an existing major transportation corridor; therefore, the existing fish and wildlife communities adjacent to the project area routinely experience disturbances associated with transportation use.

Construction of *Alternative A* would directly impact any animals that reside within the path of the proposed roadway improvements. As with the vegetation, wildlife communities would be impacted by the permanent loss of habitat. Impacts to non-rare fish and wildlife would be minimized through initial project design considerations and through the avoidance and minimization of vegetation removal and stream channel disturbance. Construction activities would disturb only that which is necessary to construct the proposed project, including minimizing disturbance to inert microhabitats (e.g., snags, brush piles). The removal of native vegetation would be avoided to the greatest extent practicable and BMPs would be utilized to avoid impacts to fish and wildlife within the project area during construction activities.

Alternative C

As discussed for *Alternative A*, required clearing or other construction-related activities may directly and/or indirectly affect animals that reside on or adjacent to the project right-of-way. Heavy machinery could kill small, low-mobility animals or could cause soil compaction, impacting animals that live underground. Larger, more mobile species would typically avoid construction activities and move into adjacent areas. Increased noise levels from construction could temporarily disturb wildlife or avian species adjacent to the roadway For *Alternative C*, the impacts to non-rare fish and wildlife resources would be expected to be similar to *Alternative A* due to the similarities in vegetation impacts and construction activities between the two *Build Alternatives*. The removal of native vegetation would be avoided to the greatest extent practicable and BMPs would be utilized to avoid impacts to fish and wildlife within the project area during construction activities.

No Build Alternative

Under the *No Build Alternative*, no vegetation or common species' habitat would be modified or removed; therefore, no impact to non-rare fish and wildlife would be anticipated.

4.10.3.2 Federally Listed Species and the Endangered Species Act

According to the USFWS (2017) and TPWD (2016) data, 23 species federally listed as threatened, endangered, or candidate species have the potential to occur in Travis County. Initial field investigations were performed in the spring and winter of 2016; it was determined that the OHP Project area contains potentially suitable habitat for three federally listed endangered species and one candidate species. The other 19 federally listed or candidate species were determined to not have suitable habitat within the OHP Project area. Additional information regarding these effect determinations and individual species' habitat requirements can be found in the *Biological Technical Report* (**Appendix J**). The species that may have suitable habitat within the OHP Project area or may be affected as a result of the proposed project are discussed in detail below.

Edwards Aquifer Salamander Species

Due to the similarities in life history characteristics and species habitat requirements (USFWS, 2015), the discussion of the Barton Springs salamander (*Eurycea sosorum*) (BSS) and Austin blind salamander (*Eurycea waterlooensis*) (ABS) is concurrent. Both species are small (about 2 inches), entirely aquatic salamanders found in springs, spring runs, wet caves, groundwater, and spring-fed tributaries of the Edwards Aquifer (USFWS, 2005). However, little is known of the biological needs of the species beyond their preference for cool, clear spring water; large cobble substrates; a reliance on aquatic invertebrates as a prey base; and their use of subsurface habitat within the underground aquifer (USFWS, 2005). While the species are known to periodically retreat underground into spring conduits, it is not known what proportion of their life cycle is spent underground. What is known is that, in contrast to the BSS, the ABS is rarely seen at spring surfaces and is assumed to be subterranean for the majority of its life (USFWS, 2013; Hillis et al., 2001). There are four main Barton Springs outlets (Parthenia, Eliza, Old Mill, and Upper) which collectively make up the Barton Springs Complex. The largest and most stable populations of BSS are within Parthenia Springs and Eliza Springs of the Barton Springs Complex (USFWS, 2013). The ABS has been found in three of the four springs in the Barton Springs Complex, but has not been observed in Upper Barton Springs.

Until recently, both the BSS and the ABS were presumed to be endemic to the Barton Springs Complex; however, recent genetic analysis of salamanders collected at several locations in southwestern Travis County and northern Hays County that discharge water to the Barton Springs Segment of the Edwards Aquifer suggest otherwise (Chippendale, 2014). Of the four collection sites discussed by Chippendale (2014), two locations (Cold Springs and Blowing Sink Cave) are indirectly associated with the OHP Project area. Cold Springs is notable because the OHP Project area is located within the Cold Springs groundwater basin (**Figure 4-11**), and dye trace studies have shown flow paths linking Williamson Creek to this location (Hauwert, 2009, 2015). Similarly, Blowing Sink Cave is located approximately 3.8 miles south of the MoPac/US 290 interchange and flow paths to Barton Springs have been mapped from this location (Hauwert, 2009). Blowing Sink cave is located within the Slaughter Creek watershed, and stormwater runoff leaving the west end of the OHP Project area and draining into Devil's Pen Creek may contribute to recharge in this area. Additionally, in 2015, a single BSS was identified from a sampling well on FM 1626, approximately 9.5 miles south of the Barton Springs Complex (TXNDD, 2016). This most recent observation confirms that the habitat for this species is not limited to the Barton Springs Complex and likely extends through the subterranean aquifer system, although the extent of the habitat and size of subterranean populations are unknown.

Urbanization and declines in water quality and quantity in the aquifer are cited by the USFWS as the primary threats to the species (USFWS, 2013). Water quality is influenced by an assortment of parameters, such as amount of impervious cover, TSS, total organic carbon (TOC), dissolved pollutants (such as heavy metals and petroleum hydrocarbons), nutrients, dissolved oxygen, and chemicals such as pesticides and herbicides. All of these have been identified by the USFWS as factors that influence the survival of aquifer-dependent salamanders. There has been substantial urbanization and development over the Barton Springs Zones since the listing of the BSS in 1997. A recent study estimated an almost 1,400-acre increase in impervious cover for the Williamson Creek watershed from 1991 to 2008 (Sung et al. 2013; Barrett, 2016). It is widely accepted that an increase in impervious cover can generate an increased volume and velocity of stormwater runoff, which can have a detrimental effect on water resources. Stormwater runoff can negatively affect water quality when it contains untreated urban pollutants such as those constituents associated with highway runoff (e.g., TSS, zinc, and other heavy metals) (Sung et al., 2013; Barrett, 2016).

According to the BSEACD, the Barton Springs segment of the Edwards Aquifer is approximately 155 square miles (BSEACD, 2003) (see Figure 4-11). Approximately 85 percent of recharge to the Barton Springs segment comes from six streams located within the Recharge Zone (USFWS, 2005). Williamson Creek and Slaughter Creek are two of these streams and both occur or have tributaries within the OHP Project area. Three groundwater basins have been delineated within this segment; Cold Springs, Sunset Valley, and the Manchaca groundwater basins and are identified on **Figure 4-16** below (Hauwert, 2009, 2015). In general, dye trace studies have concluded that most groundwater recharge in the Barton Springs segment discharges at Barton Springs, located approximately 4 miles northeast of the eastern project terminus (BSEACD, 2010; Smith et al., 2005) (**Figure 4-16**). As depicted by Hauwert (2015) (**Figure 4-16**), recent studies have linked flow paths from upper Williamson Creek to discharge sites at Cold Springs and from lower Williamson Creek to discharge sites at the Barton Springs Complex (Hauwert, 2009, 2015; Slade, 2014).

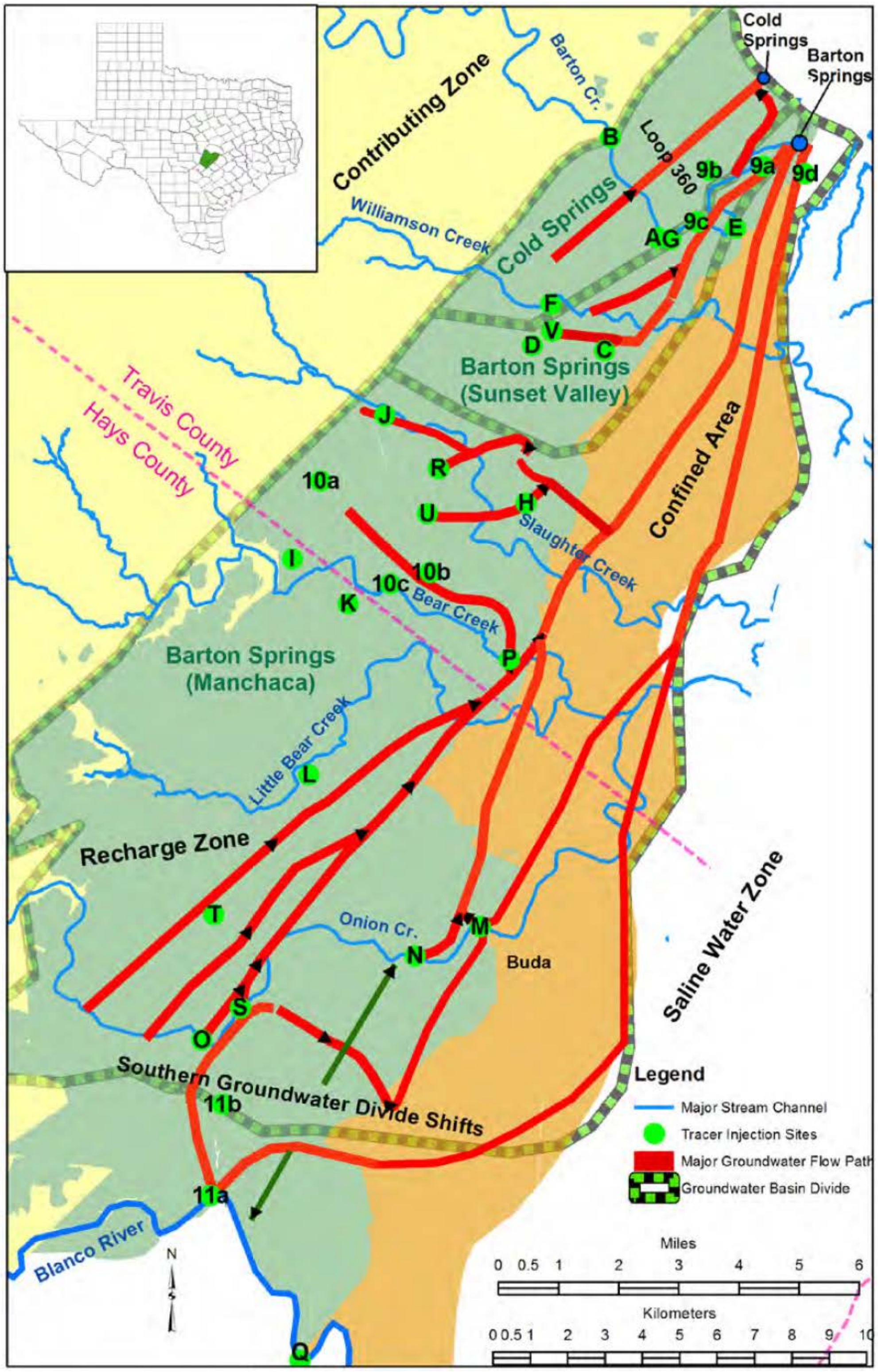

Figure 4-16. Mapped flow paths, groundwater basins, and spring locations.

Included with permission from Hauwert, 2015: Figure 2, "Injection Sites, Primary Groundwater Flow Paths, and Groundwater Divides Defined by Groundwater Tracing from 1996 to 2012 in Aquifer-Wide Traces Conducted by Barton Springs/Edwards Aquifer Conservation District and COA, with EPA 319H Funding Administered through TCEQ and COA Capital Improvement Project."

Although the majority of the Oak Hill corridor lies within the Cold Springs groundwater basin, surface water that does not recharge within features restricted to the Cold Springs basin will flow downstream through the Sunset Valley and Manchaca basins, which discharge primarily at the Barton Springs Complex. Dye trace studies have shown that potential pollutants in the upper reaches of Williamson Creek can reach Cold Springs (through groundwater paths) in about eight days and can reach Barton Springs from the lower reaches in as little as 30 hours under high flow conditions (Hauwert, 2009, 2015). Similarly, dye injected into recharge features along Slaughter Creek downstream of the project area was recovered from Parthenia, Eliza, and Old Mill outlets at the Barton Springs Complex after 7 to 8 days (Hauwert, 2009, 2015). These results suggest that water quality at Barton Springs is directly influenced by surface water recharging into features throughout the Barton Springs segment of the aquifer, which could affect both salamander species through a degradation in water quality, particularly during storm events.

A GA was conducted for the portion of the OHP Project area occurring over the Edwards Aquifer Recharge Zone (TxDOT, 2009, 2017; **Appendix D**). In all, eight potential recharge features were identified in 2009 but only six features were found during an updated survey conducted in 2017 (see **Figure 4-17** for the geologic features). Four of these features were evaluated as sensitive, with potential for infiltration into the aquifer. Because groundwater moves through highly permeable fractures and voids, the aquifer has little ability to filter potential contaminants. This characteristic makes the Edwards Aquifer's water quality highly dependent on the quality of surface water flowing over the Recharge Zone and makes the aquifer species particularly susceptible to upstream contamination (Mahler and Massei, 2007).

To date, there has been no critical habitat designated for the BSS; however, in 2013, the USFWS designated one Critical Habitat Unit (CHU) for the ABS. This CHU encompasses 120 acres surrounding the Barton Springs Complex, including both surface habitat at the spring outlets and subsurface habitat extending 984 feet in all directions from spring outlets. As discussed previously, the OHP Project area occurs partially within the Barton Springs Segment of the Edwards Aquifer. It is likely that the subsurface geology under the portions of the project area occurring within the Recharge Zone could support the appropriate water, conduits, and aquatic food sources required to sustain either the ABS or the BSS; however, there is no designated subsurface critical habitat within or adjacent to the OHP Project area.

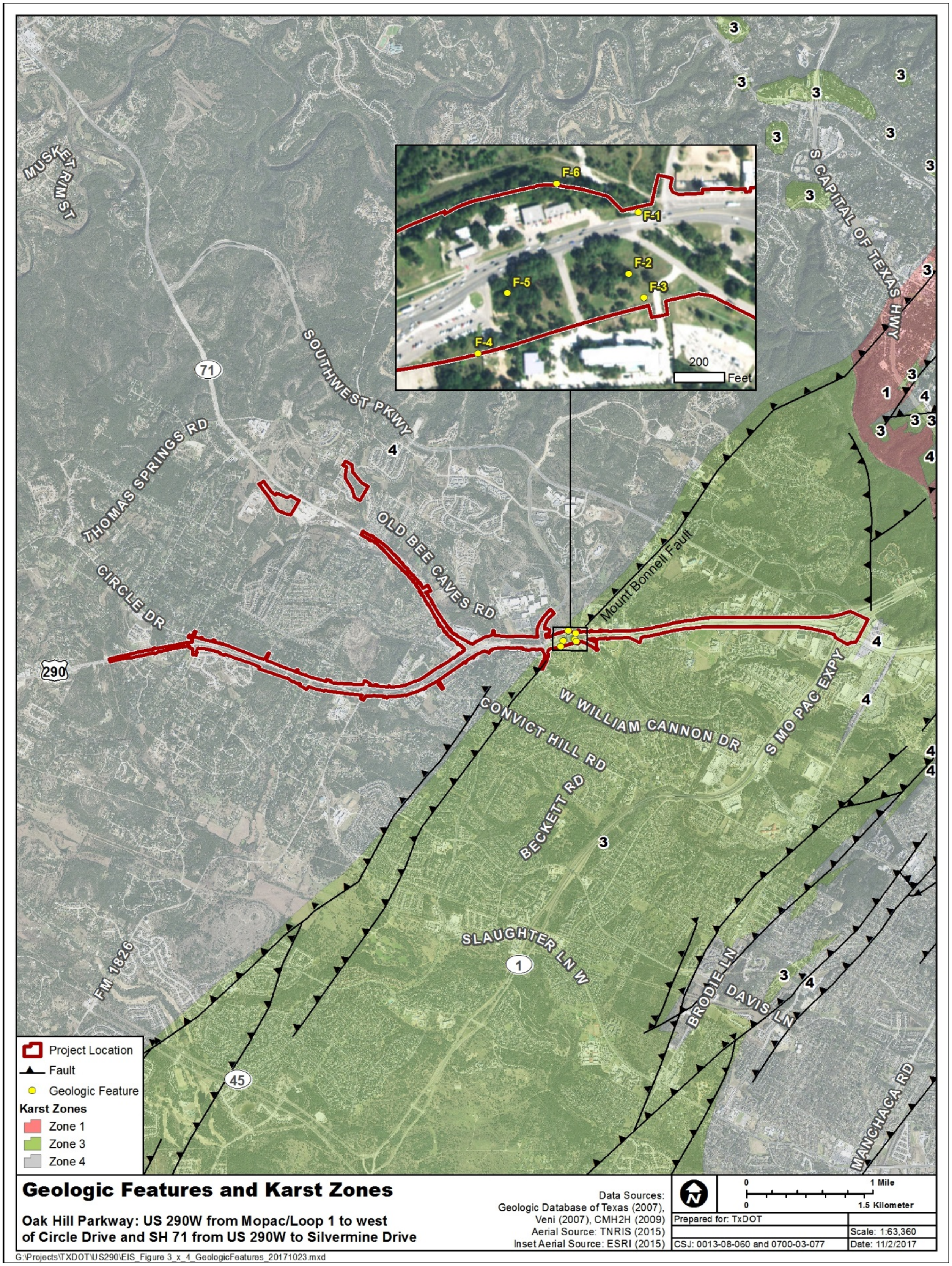

Figure 4-17. Geologic features and karst zones in the OHP Project area.

Bee Creek Cave Harvestman—Federal Endangered and State SGCN

The Bee Creek Cave harvestman (*Texella reddelli*) is a small troglobitic arachnid known from only a small number of caves in Travis County. This species has long appendages, small eyes, and relies on limestone caves with near 100 percent humidity and constant temperatures. Like most *Texella*, this species preys on springtails. This species is unique in its dispersal across Travis County due to its occurrence both north and south of the Colorado River, which is typically a barrier for most terrestrial troglobytes, including the other federally listed invertebrates in Travis County (USFWS, 1994).

The closest occupied feature to the OHP Project area is located on the Barton Creek Greenbelt, approximately 2 miles northeast of the MoPac/US 290 interchange. A GA was conducted along the project corridor for the area mapped as Karst Zone 3, but a karst habitat assessment has not been completed. None of the features identified in the GA were described as having cave characteristics or were measured at a depth that would support constant temperatures and humidity. A detailed description of the karst features identified during the survey can be found in the GA (**Appendix D**). Additionally, a review of Texas Speleological Survey data did not include any records for existing recharge or cave features within the project area (Texas Speleological Survey, 2008). Although the OHP Project occurs within the South Travis County Karst Fauna Region, the project area crosses Karst Zones 3 and 4 (**Figure 4-17**), areas that are unlikely to contain listed karst invertebrates (Veni and Martinez, 2007). The proposed project is not anticipated to affect the Bee Creek Cave harvestman.

Bracted Twistflower—Federal Candidate and State SGCN

The bracted twistflower (*Streptanthus bracteatus*) is a rare annual wildflower endemic to south-central Texas that became a federal candidate for listing in 2011. This species is thought to be a geological or edaphic plant endemic to limestone or dolomite and is adapted to full sun exposure on rocky outcrops. All known populations have been observed in areas less than 0.75 mile from the Balcones Fault Zone (Pepper 2010). Known threats include the development of private land, recreational activities on public land, and deer herbivory (Leonard 2010; Pepper 2010; USFWS 2011). According to the USFWS (2011), the greatest threat to this species is habitat loss due to urban and residential land development. Given its vulnerability and attractiveness to herbivores, particularly white-tailed deer, it is often found amid dense shrubs that afford some physical protection. Fall and winter rainfalls stimulate seed germination, with flowering occurring in the spring in displays of showy, lavender-purple flowers (NatureServe, 2012; Poole et al., 2007). Pedestrian surveys for this species were conducted during the flowering period in the spring of 2016, but no individuals were observed.

Alternative A

Edwards Aquifer Salamander Species

Potential impacts to sensitive aquatic species associated with the construction and operational phases of roadways include impacts from altered hydrology and impacts from roadway-associated pollution. Pollutants can enter the aquatic environment via untreated stormwater runoff or spills, and the addition of impervious cover can influence the volume and quality of runoff leaving the project area. The Recharge Zone of the Barton Springs segment encompasses approximately 78 square miles (or 50,000 acres). Approximately 74.0 acres of impervious cover would be added as a result of *Alternative A* (KFA, 2017). The new impervious cover would be less than 0.15 percent of the Barton Springs Recharge Zone total. Construction activities such as excavation, trenching, geotechnical boring, and vegetation clearing could increase the sediment loading in stormwater by loosening topsoil and increasing the erodibility of surfaces within the project area. This loosened sediment could be transported down-gradient and deposited in recharge features, stream terraces, or other water bodies by runoff or rainfall. In the designation of critical habitat for the ABS, the USFWS identified dissolved oxygen, conductivity, sedimentation, and point and non-point source contaminants as water quality parameters that have the potential to impact sensitive species (USFWS, 2013). Direct impacts caused by construction activities and indirect impacts caused by operation and maintenance of roadway facilities over time could have a negative impact on the water quality parameters mentioned above.

A recent report by Barrett (2016) evaluated the results of over 20 years of water quality data, including roadway runoff constituents (TSS and zinc) at Barton Springs. Barrett's report also examined the effectiveness of typical BMPs that are frequently used to treat stormwater runoff under COA regulations and the TCEQ Edwards Aquifer Rules. He concluded that these typical BMPs are successful at removing pollutants from highway runoff and cited the findings of historical water quality data collected by the COA and the USGS at Barton Springs. Of particular importance to highway runoff are TSS, zinc, and copper levels, all of which have been stable or decreasing over the last 20 years despite the increased urbanization over the Barton Springs Zone (Barrett, 2016). Several water quality constituents (nitrate, dissolved oxygen, sulfate, calcium, strontium, etc.) studied in Barrett's report were found to have worsened over the same period (Herrington and Heirs, 2010; Barrett, 2016). The increase in these constituents is explained in detail by Barrett (2016) but are thought to be a result of an increase in septic or wastewater systems throughout the Barton Springs Zone (Mahler et al., 2011). The increases in many of the other constituents can be explained as the result of their natural occurrences in the aquifer and by the increased water supply demands, which can cause saline water from the eastern boundary of the Edwards Aquifer to move west and increase its discharge at Barton Springs (Mahler et al., 2006). Based on Barrett's analysis, none of the water quality data analyzed for Barton Springs indicated any degradation due to stormwater runoff or an increase in impervious cover.

Barrett's (2016) report also focused on the effectiveness of various BMPs for stormwater runoff within the Barton Springs Zone. He concluded that, based on the water quality analysis of the constituents that are typically found in stormwater or highway runoff, the TCEQ and COA BMP standards are effective at preventing degradation to water quality by matching or improving on background water quality parameters (Barrett, 2016).

As discussed previously, no springs or caves occur within the OHP Project area and all known locations of BSS or ABS are at a considerable distance from the limits of *Alternative A*. The greatest possibility of direct effects to these species could occur if voids connected to the aquifer or containing groundwater are intersected during the down cutting of bedrock below the current grade or other excavation activities, such as for bridge piers. Preliminary design indicates that *Alternative A* would require the placement of approximately 167 columns within the Recharge Zone. Columns would reach depths between 19 and 33 feet, which would be shallower than all but one of the recorded wells near the project area. Therefore, any direct impacts, including mortality or physical harm caused by construction activities, are extremely unlikely to occur.

However, based on the project-related increase in impervious cover, the project's location over the Recharge Zone of the Edwards Aquifer, and the known aquifer flow paths to Barton Springs from the impacted watersheds, this project may impact water quality through increased stormwater contribution; therefore, this project may contribute to the downstream degradation of water quality parameters that are essential to the BSS and ABS at discharge sites within the Barton Springs Complex. However, once stormwater leaves the OHP Project area and infiltrates into the subsurface environment (e.g., groundwater), the flow path and amount of mixing with other subsurface waters is unknown.

To mitigate for the increase of impervious cover within the OHP Project area and to ensure protection of downstream resources (including salamanders), BMPs would be applied to reduce the intensity of stormwater runoff and amount of roadway pollutants entering Williamson and Slaughter Creeks. The proposed OHP Project would strictly adhere to the TCEQ standards for BMPs over the Edwards Aquifer and would commit to at least 80 percent removal of the incremental increase in TSS resulting from the proposed projects' addition of impervious cover. A *Preliminary Water Quality Analysis and Design Report* (KFA, 2017) has been prepared to address permanent water quality BMPs for the OHP Project (**Appendix H**); in summary, the following BMPs have been recommended as permanent water quality protection measures for the OHP Project:

1. BMPs to protect water quality during both the construction and operation phases of the roadway will be implemented as defined by the WPAP and the SW3P.
2. Use of permanent BMPs, such as VFS, an HMT at Williamson Creek, bioretention ponds, extended detention ponds, and sand filter ponds (as described in **Appendix H**) will be utilized throughout the OHP Project area.
3. Specific void mitigation measures will be followed for any unknown void encounters to protect the Edwards Aquifer from TSS during construction.
4. Buffers will be established to prevent impacts to the known recharge features in Williamson Creek during the construction phase of the project. BMPs, such as avoidance flagging or fencing, rock filter dams, and sediment control fencing, may be included to prevent impacts to these features.

TxDOT and the Mobility Authority have determined that the proposed *Alternative A* may affect, but is not likely to adversely affect the federally endangered BSS and ABS. While the OHP Project area is within range of these species, there are no recorded occurrences of the species in close proximity to the OHP Project area, suitable surface habitat is lacking in the OHP Project area, and the population of the salamanders is diffuse relative to the entire area of the Edwards Aquifer. The proposed BMPs would protect surface water and groundwater in the OHP Project area by minimizing erosion; reducing TSS; and reducing the rate and velocity of discharged stormwater, which would decrease flood potential and thus reduce the amount of roadway contaminants potentially reaching the Barton Creek watershed during storm events. Accidental discovery plans, void mitigation measures, and water quality protection BMPs would further protect the Edwards Aquifer from TSS during construction. No effect to the CHU for the ABS at Barton Springs would occur as a result of constructing *Alternative A*.

Bee Creek Cave Harvestman

Although the OHP Project occurs partially within the South Travis County Karst Fauna Region, the nearest record of occurrence for a listed karst invertebrate is located more than 2 miles north of the eastern project terminus. A GA was conducted for areas of the project which occur over the Recharge Zone of the Edwards Aquifer (TxDOT, 2009; HDR, 2016). Several sensitive recharge features were identified; however, no features exhibited the habitat characteristics required for listed karst invertebrates. Although *Alternative A* would minimize the need for excavation activities to the extent practicable, the potential for impacting an undiscovered cave or void remains. Excavation, geotechnical boreholes, and bridge pier drilling have the potential to alter a cave's ecosystem. However, due to the lack of suitable karst features identified during the GA and the fact that the OHP Project area is mapped as Karst Zone 3 (i.e., areas that probably do not contain endangered cave fauna), this alternative is not anticipated to have an effect on listed karst invertebrates. Accidental discovery plans, void mitigation, and protective BMPs would be utilized if a void were discovered during project construction.

Bracted Twistflower

While this species could possibly occur within the OHP Project area where gravelly clay and clay loam soils exist, it is not likely given the disturbed nature of the woodlands along the corridor and the prevalence of herbivores such as the white-tailed deer. Given the uncertainty associated with its presence or absence, the construction of *Alternative A* may potentially affect this species due to the disturbance of approximately 78.07 acres of suitable woodland habitat. Candidate species receive no statutory protection under the Endangered Species Act (ESA). If this species should become federally listed during the environmental review or construction phase of the OHP Project, additional coordination with the USFWS will occur.

Alternative C

Edwards Aquifer Salamander Species

As discussed previously, no springs or caves are known to occur within the OHP Project area, and all construction activities would occur approximately 2.6 miles southwest of the closest known location for the ABS and BSS. The potential effects of the proposed project would be similar to those described for *Alternative A* above, although *Alternative C* would add approximately 73.6 acres of impervious cover to the OHP Project area, which is 0.4 acres less than *Alternative A*. Similarly, *Alternative C* is anticipated to require the placement of 152 columns within the Recharge Zone, which is 15 less than *Alternative A*. TxDOT and the Mobility Authority propose to meet the same TCEQ Water Quality Standards for this *Build Alternative* and would commit to the same BMPs for protection of the Edwards Aquifer as described for *Alternative A*. Therefore, TxDOT and the Mobility Authority have determined that the proposed *Alternative C* may affect, but is not likely to adversely affect the federally endangered BSS and ABS. While the OHP Project area is within range of these species, there are no recorded occurrences of the species in close proximity to the project area, suitable surface habitat is lacking in the OHP Project area, and the population of the salamanders is diffuse relative to the entire area of the Edwards Aquifer.

Bee Creek Cave harvestman

The potential to encounter this species during the construction of *Alternative C* would be remote considering the distance to a known occupied feature and due to the project's location in Karst Zone 3, as discussed above. No effect to this species is anticipated and any impact to karst features would be similar to those described for *Alternative A*.

Bracted Twistflower

Alternative C may potentially affect this species due to the disturbance of approximately 78.07 acres of suitable woodland habitat, which would be the same amount of vegetation as *Alternative A*. Candidate species receive no statutory protection under the ESA. If this species should become federally listed during the environmental review or construction phase of the OHP Project, additional coordination with the USFWS will occur.

No Build Alternative

Under the *No Build Alternative,* stormwater runoff would continue to flow into adjacent streams and recharge features, while vehicular traffic on the roadway would continue to increase. Temporary changes to water quality as a result of the construction phase of the project will not occur. However, an important change to the existing conditions under either *Build Alternative* will be the inclusion of required BMPs to control the quality, quantity, and velocity of water, including roadway runoff, entering streams and recharge features with flow paths to Barton Springs. It is possible that new BMP implementation under either *Alternative A* or *Alternative C* will result in an improvement to water quality leaving the OHP Project area, especially with the inclusion of an HMT, which is currently absent from the project area. It is also anticipated that due to the US 290 bridge improvements and the creation of upstream detention basins under the *Build Alternatives,* there would be a reduction in flood levels (0.5 feet) in Williamson Creek that would reduce overland flow into the Barton Creek watershed. Under the *No Build Alternative* the flood levels would remain the same (see **Appendix I** for the hydrology and hydraulics study). Under the *No Build Alternative*, no effects to the Bee Creek Cave harvestman or the bracted twistflower would occur.

4.10.3.3 State-Listed Species and Species of Greatest Conservation Need

In addition to the federally listed/candidate species described above, five additional species designated by TPWD (2016) as state threatened or endangered have the potential to occur in Travis County: false spike mussel (*Fusconia mitchelli)*, Texas horned lizard (*Phrynosoma cornutum*), American peregrine falcon (*Falco peregrinus anatum*), peregrine falcon (*Falco peregrinus*), and the bald eagle (*Haliaeetus leucocephalus*). However, none of these species or their habitat were observed during field visits. TPWD also lists species with no regulatory status that are considered SGCN in Texas that could occur within Travis County. SGCN are species that, due to limited distributions and/or declining populations, face the threat of extirpation or extinction but lack legal protection. TPWD designated 42 SGCN species as having the potential to occur in Travis County that are not listed as candidates or federally protected under the ESA. Of these 42 species, suitable habitat occurs within the OHP Project area for 18 plants, 2 mammals, 1 fish, and 1 reptile as determined by qualified biologists during visual surveys in January, May, and June of 2016. Additional information regarding the impact determinations, individual species habitat requirements, and the TXNDD database query can be found in the *Biological Technical Report* (**Appendix J**). The SGCNs that may have suitable habitat within the OHP Project area or may be impacted as a result of the proposed project are discussed in detail below.

Plants

Although the OHP Project area is primarily a suburban community of residential and commercial properties, it has fragmented patches of native vegetation along US 290 from west of William Cannon to the project terminus and along SH 71 north of Scenic Brook at the creek crossings and detention pond locations. The vegetation communities in these areas are best described as Ashe juniper motte and woodlands, deciduous oak/evergreen woodlands, savanna grasslands, and small tracts of riparian forest along the creeks and streams (see **Figure 4-14** above). The majority of the OHP Project area is underlain by clays and clay-loam soils derived from limestone. These gravelly, calcareous soils provide suitable substrate for many plant species adapted to the eastern Edwards Plateau. Generally, the 18 SGCN plant species identified to have potential suitable habitat within the OHP Project area would occur in either the mixed woodland or grassland vegetation communities or along the riparian corridors. The mixed woodland and grassland species are: boerne bean (*Phaseolus texensis*), Buckley tridens (*Tridens buckleyanus*), Glass Mountains coral-root (*Hexalectris nitida*), Heller's marbleseed or Heller's false gromwell (*Onosmodium helleri*), plateau milkvine (*Matelea edwardensis*), Texabama croton (*Croton alabamensis* var. *texensis*), Texas almond (*Prunis minutiflora*), Texas amorpha (*Amorpha roemeriana*), Texas barberry (*Berberis swaseyi*), Texas fescue (*Festuca versuta*), Texas milk vetch (*Astragalus reflexus*), Texas seymeria (*Seymeria texana*), tree dodder (*Cuscuta exaltata*), and Warnock's coral root (*Hexalectris warnickii*). The riparian or alluvial channel species are: gravelbar brickellbush (*Brickellia dentata*), low spurge (*Euphorbia peplidion*), narrowleaf brickellbush (*Brickellia epatoroides* var. *gracillima*), and rock grape (*Vitis rupestris*).

According to TPWD data, all of these species have a range that extends across the Edwards Plateau, and none are restricted solely to the habitats occurring within the OHP Project area.

Cave Myotis Bat

The cave myotis bat (*Myotis velifer*) is an insectivorous bat and is the largest myotis species within the Central Texas environment. It inhabits a wide variety of habitats, many of which are associated with riparian areas or waterways within arid or semiarid environments. Its range stretches across the Southwestern U.S. into Central America. In Texas, they are common from the southwestern counties through the Edwards Plateau and into the northwestern portion of the Panhandle (Tuttle, 2003). This species mates from September to March and forms maternity colonies from April to May. Cave myotis bats commonly roost in rock crevices, caves, old buildings, bridges, and culverts and hibernate during the winter in groups (Tuttle, 2003).

Plains Spotted Skunk

The plains spotted skunk (*Spilogale putorius interrupta*) is a slender-bodied skunk with distinctive white spots, six anterior dorsal stripes, and a white-tipped black tail. Smaller and more active than other skunks common to Texas, this species is almost entirely nocturnal and is rarely observed during the daytime (Schmidly, 2004). This species is catholic in its range but is most often associated with wooded areas and tall grass prairies. Where available, rock outcrops and rocky canyons are preferred (Schmidly, 2004). Although urban habitation is less common, this species can be found around agricultural fields and low-density residential areas. Their den sites range from tree cavities to rock crevices, burrows under large rocks, and under buildings. Like many omnivores, this species' diet consists of fruits, small mammals, bird eggs, and insects. Population dynamics for the plains spotted skunk are not well understood. The species was once relatively common but is now believed to be rare across the state and its current status is unknown. Although the preferred habitat of tall prairie grasses is lacking in the project right-of-way, the small undeveloped tracts of land adjacent to the project right-of-way cannot be excluded as potential habitat for this species, especially those areas along US 290 with rocky outcrops. No individuals or suitable den sites were identified during field investigations.

Guadalupe Bass

The Guadalupe bass (*Micropterus treculii*) is endemic to streams of the Edwards Plateau, including portions of the Brazos, Colorado, Guadalupe, and San Antonio river basins (Hendrickson and Cohen, 2015). The species is typically absent from extreme headwaters and prefers spring-fed streams with clear water and consistent temperatures, and lentic environments with flowing water, eddies, riffles, and deep pools (Hendrickson and Cohen, 2015; TPWD, 2015). The preferred habitat elements for the Guadalupe bass are silt substrates, large rocks, and cypress knees, though the species will use varying stream substrates depending on available conditions (Perkins et al., 2010). The main branch of Williamson Creek is the only stream with potentially suitable habitat within the OHP Project area. This species is unlikely to persist year-round within Williamson Creek due to the perennial drought conditions that typically occur during summer months; however, individuals may migrate upstream in high-flow events during spawning periods (early March through May or June). Although juvenile fish were noted within Williamson Creek during field investigations, no identification or collection efforts took place.

Texas Garter Snake

The Texas garter snake (*Thamnophis sirtalis annectens*) generally inhabits mesic Hill Country streams with permanent water or soil moisture in floodplains but can be found in a wide range of habitats, including drainage ditches, metropolitan areas, and grassy or brush vegetation (Werler and Dixon, 2010). This species is generally uncommon throughout its range but, like most other garter snakes, its secretive nature and preference for dense ground cover often inhibit detection. Although no individuals of this species were observed during site visits, the presence of Texas garter snakes in the riparian corridors associated with Williamson Creek, Wheeler Branch, Devil's Pen Creek, and the unnamed tributaries across the OHP Project area cannot be ruled out.

Alternative A

Pedestrian surveys were conducted where right-of-entry was granted within the OHP Project area; qualified biologists walked these areas on multiple occasions (January, May, and June of 2016) and visually inspected the unmaintained vegetation, embankments, and riparian areas for presence of SGCN species. Additionally, the following structures with National Bridge Inventory (NBI) numbers were investigated for suitable bat habitat: US 290 over Williamson Creek (NBI 142270011308022), William Cannon Drive over Williamson Creek (NBI 142270B03854003), SH 71 over Draw (NBI 142270070003013), SH 71 over Williamson Creek (NBI 142270070003012), and US 290 over Draw (NBI 142270011308048). No individuals of any state-listed species or SGCNs were identified during these surveys. Prior to construction, additional field reconnaissance would be conducted to assess whether any species or rare habitat communities would be impacted in areas that had not been previously studied.

As described in **Section 4.10.3.1**, potential impacts to the SGCNs discussed above could be attributed to mobile species interacting with or avoiding construction machinery, the loss of wildlife habitat, habitat fragmentation, vehicle collisions, and through the direct removal/disturbance of plant populations or individuals. *Alternative A* would require the removal of approximately 121.35 acres of non-urban vegetation that may provide suitable habitat for the species discussed above. Additionally, although no bridges within the project right-of-way exhibited suitable habitat for the cave myotis bat (the bridges lack the structural components typically utilized by bats), bats may roost in culvert locations, abandoned buildings, swallow nests, or rocky outcrops within the project area. No impacts to state-listed species or their habitats are anticipated.

Alternative C

The impacts resulting from the construction of *Alternative C* would be expected to be similar to those described for *Alternative A*; however, *Alternative C* would impact approximately 1.44

acres less riparian vegetation than *Alternative A*. This alternative is not anticipated to impact any state-listed species or their habitats.

No Build Alternative

Under the *No Build Alternative*, there would be no impact to state-listed species or SGCNs.

Encroachment-Alteration Effects

Encroachment-alteration effects stemming from the proposed project could result in additional loss and fragmentation of vegetation and habitat types on developable lands within the OHP Project area and an increase in impervious cover. Development in general encroaches on vegetation, and reductions in vegetation typically equate to reduced wildlife habitat and increases in impervious cover. For this project, however, impacts to habitat would be limited to the area of direct impact, which is generally already developed and adjacent to an existing transportation corridor; therefore, no encroachment-alteration effects are expected to occur to common wildlife or vegetation communities.

No encroachment-alteration effects on listed karst species are expected because the OHP Project area lies outside the known range of all listed karst invertebrate species. No encroachment-alteration effects on state-listed species are expected because the OHP Project area lacks suitable habitat and the OHP Project area is mostly developed land. Possible encroachment-alteration effects to SGCNs from the proposed project would be generally similar to those expected as a result of construction of the proposed project. Any development occurring in direct response to the OHP Project would decrease vegetative cover, likely causing non-significant decreases in prey availability to foraging SGCN reptiles and mammals. Any plants within new development areas would likely be destroyed.

Encroachment-alteration effects to the federally listed salamanders could occur as a result of habitat loss due to increased development in the area, an increase in edge habitat, or an increase in impervious cover limiting recharge to the Edwards Aquifer. Both the BSS and ABS are entirely dependent on the Edwards Aquifer. Changes to the aquifer as a result of decreased recharge or an increase in pollutants in stormwater runoff (stemming from increased impervious cover in the Recharge Zone) may affect, but are not likely to adversely affect, these species. While additional residential or commercial development may occur in the future on the Recharge Zone within the project area, it would largely be expected to occur independently of the US 290/SH 71 improvements, and any effects of that development on the ABS and BSS as a result of changes to the quality or quantity of water discharging at Barton Springs would not be attributable to construction of the OHP Project. If development were to occur in direct response to the presence of the OHP, it seems likely to occur on the western end of US 290 or the northern end of SH 71 within the OHP Project area, which is outside of the Recharge Zone. Through the use of BMPs, at least 80 percent of the incremental increase in TSS load generated by the increase in impervious cover over the Recharge Zone would be removed. These BMPs would mitigate for impacts generated from an increase in impervious cover and stormwater runoff from the proposed project.

4.11 Cultural Resources

Cultural resources are buildings, structures, objects, sites, and districts. Archeological resources are sites and locales containing interpretable material traces of past human activity in the form of artifacts, ruins, structural remnants, or other human-made feature remains either on the surface or buried below ground. Archeological resources include materials and artifacts ranging in age from more than 10,000 years old to 50 years old.

4.11.1 Regulatory Requirements

Compliance with the laws that protect cultural resources often requires consultation with the Texas Historical Commission (THC), the Texas State Historic Preservation Office (SHPO), and/or federally recognized tribes to determine the proposed improvements' impacts on cultural resources. Review of and coordination on the proposed OHP Project would follow approved procedures for compliance with state and federal laws.

Both state and federal laws mandate the consideration and protection of cultural resources during the project planning stage. At the federal level, NEPA and the National Historic Preservation Act (NHPA) of 1966 (among other laws and regulations) apply to transportation projects. Review and coordination of the proposed OHP Project was prepared in accordance with approved procedures for compliance with state and federal laws, including the *Programmatic Agreement Among the Federal Highway Administration, the Texas Department of Transportation, the Texas State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Implementation of Transportation Undertakings*.

At the state level, the proposed project is subject to the provisions of the Antiquities Code of Texas (ACT) because it involves "lands owned or controlled by Texas or any city, county, or local municipality thereof." The ACT allows for resources to be considered as potential State Antiquities Landmarks (SALs) and requires that each be examined in terms of possible "significance." Significance standards for the code are clearly outlined in Chapter 26 of the THC's Rules of Practice and Procedure for the ACT. At the state level, an archeological site's significance is determined by one or more of the following criteria:

1. a site has the potential to contribute to a better understanding of the prehistory and/or history of Texas by the addition of new and important information;
2. a site's archeological deposits and the artifacts within the site are preserved and intact, thereby supporting the research potential or preservation interests of the site;
3. a site possesses unique or rare attributes concerning Texas prehistory and/or history;
4. the study of a site offers the opportunity to test theories and methods of preservation, thereby contributing to new scientific knowledge; and

5. there is a high likelihood that vandalism and relic collecting has occurred or could occur, and official landmark designation is needed to ensure maximum legal protection, or alternatively, further investigations are needed to mitigate the effects of vandalism and relic collecting when the site cannot be protected.

If the lead agency and the SHPO agree that a resource potentially affected by a proposed project is eligible for inclusion in the National Register of Historic Places (NRHP), then they are required to apply the Criteria of Adverse Effect found in 36 CFR Section 800.5 to such a resource. Under this regulation, an "adverse effect is found when an undertaking may alter directly or indirectly any of the characteristics of the resource that make it eligible for the NRHP." An adverse effect may be found when such characteristics are altered "in a manner that would diminish the integrity of a resource's location, design, setting, materials, workmanship, feeling, or association." If an adverse effect is determined, then the regulations require the federal agency and the SHPO to seek ways to avoid the resource, minimize the impacts, or mitigate for effects.

4.11.2 Archeological Resources

This section summarizes the archeological resources within the OHP Project area of potential effects (APE), defined as the footprint of the project, and the proposed project's potential impacts to archeological resources. The *Cultural Resources Technical Report* and *Update for Oak Hill Parkway Archeological Survey Memorandum* (Appendix K) provide a constraints analysis on archeological resources and details regarding the methods and findings of the archeological resources studies for the proposed OHP Project.

4.11.2.1 Existing Conditions and Previous Investigations

According to Atlas survey coverage data (THC, 2016), US 290 was surveyed in the 1980s for TxDOT (at that time known as the Texas Department of Highways and Public Transportation, or TDHPT). More recent follow-up work was conducted in 2006 by GTI Environmental and PBS&J (now Atkins North America) for additional right-of-way at the "Y" (Ellis et al., 2009). Not all portions of the APE that are known to have been surveyed are depicted in Atlas data; this includes portions of SH 71 and US 290 that were surveyed in the mid-1980s (Budd, 2005).

Many other surveys have been conducted in areas adjacent to the APE and within the 1-kilometer (0.62-mile) study area, including: a survey performed in 2007 by Geo Marine, Inc. (GMI; now Versar, Inc.) of SH 71 just west of the current terminus of the APE on SH 71; multiple surveys carried out for the U.S. Department of Housing and Urban Development (HUD) in the 1970s and 1980s; and multiple small area surveys along the US 290/SH71 intersection (e.g., small GTI Environmental projects presented in Ellis et al., 2009).

4.11.2.2 Previously Recorded Archeological Sites

Review of the THC's Archeological Sites Atlas on August 8, 2016, revealed 54 archeological sites within the 1-kilometer (0.62-mile) study area (including four within the APE, discussed below), 6 cemeteries, and 2 historical markers (THC, 2016).

Four previously recorded sites are located within the project's APE (41TV122, 41TV274, 41TV279, and 41TV2194). No cultural material was observed within the existing right-of-way at the locations of previously documented sites 41TV122, 41TV279, and 41TV2194. Right-of-entry was not available for the parcel within which site 41TV274 is plotted. However, the location specified in the site form is inconsistent with the mapped location. Specifically, the site form places the site location at Convict Hill Road, near an old spring. The plotted location is on a limestone ridgetop which has been truncated by the deep US 290 road cut, west of William Cannon Road. The existing right-of-way at site 41TV2194 is also cut below grade and no artifacts were noted, with the caveat that most of the site area was inaccessible at the time of survey. Additional investigations at site 41TV2194, commensurate with the level of integrity and/or disturbance of the area, are recommended when right-of-entry is obtained for this area; this recommendation is based on the information provided in the initial site record for the site.

4.11.2.3 State Antiquities Landmarks

According to THC's Archeological Sites Atlas, no State Antiquities Landmarks are located within the project's APE or the 1-kilometer (0.62-mile) study area.

4.11.2.4 Cemeteries

As mentioned in **Section 4.2.3**, a small portion of the proposed OHP Project improvements would take place on a parcel associated with the Forest Oaks Memorial Park (TV-C035), a perpetual care cemetery maintained by Cook Walden. The proposed right-of-way on this parcel is a small section (less than 1 acre) located along the previously disturbed, paved entrance to the west side of the park, as well as a portion of a previously disturbed grassy area adjacent to William Cannon Drive that includes buried utility installations. No marked burials are located in this area, and the nearest marked burial is located roughly 39 feet away from the APE. The oldest burials in the cemetery date to the mid-1950s.

During individual stakeholder meetings conducted by the project team in April 2016 and March 2017, TxDOT was able to confirm with Cook Walden (the company that oversees the Forest Oaks Memorial Park) that no burials or future burial plots are located within the proposed right-of-way. The meeting summary reports for these stakeholder meetings are available for review by request at the TxDOT Austin District Office.

Based on the disturbed condition of the APE near this cemetery, the relatively recent age of the burials, and information from consultation with the proprietors of the cemetery, this project has a low probability of encountering human burials. However, if burials or any unanticipated cultural materials or deposits are found at any stage of clearing, preparation, or construction, work should cease in that area; TxDOT and Travis County should be notified immediately; and all requirements of 8 THSC 711 should be followed.

4.11.2.5 Environmental Consequences

On behalf of TxDOT and in accordance with the ACT (9 TNRC 191) and Section 106 of the NHPA, as amended (16 U.S.C. 470; 36 CFR 800), Cox|McLain Environmental Consulting, Inc.

(CMEC) conducted intensive archeological survey of proposed improvements to US 290 and SH 71 roughly centered on the "Y" in Oak Hill. CMEC's intensive investigations indicate little to no potential for encountering intact archeological deposits within the existing right-of-way or accessible portions of proposed right-of-way because of extensive modern disturbance. Two new sites, 41TV2516 and 41TV2517, were recorded; both are sparse, shallow, lithic scatters lacking buried components or other characteristics that might contribute to NRHP or SAL eligibility. Disturbances caused by roadway construction and maintenance activities, utility installation, commercial development, and residential development were noted throughout the APE (**Appendix K**).

Based on the extensive disturbances noted, no additional archeological investigation is recommended for the existing TxDOT right-of-way (313.64 acres or 126.93 hectares) or surveyed portions (24.00 acres or 9.71 hectares) of proposed right-of-way prior to construction activities. However, the project team recommends the completion of pedestrian inspection with subsurface testing as needed for the 53.58 acres (21.68 hectares) of proposed right-of-way that was not accessible or observable from the existing right-of-way at the time of survey. This acreage includes the areas of previously documented sites 41TV274, 41TV2194, and adjacent to newly documented site 41TV2516 (**Appendix K**).

The undertaking's APE has previously been subject to multiple archeological investigations and multiple instances of Section 106 and ACT consultation conducted with both the Texas SHPO and Native American Indian Tribes. SHPO consultation was previously conduced in letters dated June 5, 1985; March 20, 1987; March 30, 1987; December 16, 2004; March 30, 2005; May 18, 2006; and January 17, 2017. Consultation with Native American Indian Tribes interested in the area encompassing the APE has been previously conducted in letters and emails dating April 26, 2006; May 19, 2006; January 27, 2012; February 9, 2017; March 3, 2017; and April 3, 5, and 11, 2017.

The consultations concluded with the SHPO concurring with TxDOT's recommendations that sites found to be overlapping onto the APE do not contribute to any of the sites' eligibility for listing on the NRHP. The SHPO also concurred with TxDOT's determinations that no further work or consultation is required for the 313.64 acres of existing right-of-way within the APE. The SHPO also concurred with TxDOT's determination that no further work or consultation is required for all of the portions of the APE that have been surveyed to date.

However, due to denial of right-of-entry, approximately 53.58 acres of proposed new right-of-way and easements still require archeological assessment and consultation. Please see **Appendix K** for the document entitled, "12 July 2017 Documentation of Areas Still Requiring Survey and Section 106 Consultation" for the location and additional information about these unsurveyed areas. As allowed under the PA for transportation undertakings among TxDOT, the THC, the FHWA, and the Advisory Council on Historic Preservation, the TxDOT Environmental Affairs Archeological Studies Branch confirmed on October 18, 2017, that due to lack of right-of-entry to outstanding parcels required to complete Section 106 and ACT consultation, the project should be permitted to proceed with proposed the NEPA process (see TxDOT Internal Memo dated October 18, 2017, in **Appendix K**).

TxDOT shall ensure that all archeological assessments as well as Section 106 and ACT consultation is completed prior to the commencement of construction within the 53.58 acres of proposed new right-of-way/easements that still require assessment and consultation.

Alternative A

Alternative A has moderate potential for surficial archeological sites due to the prevalence of such sites in Central Texas, although there is a low potential for them to contain deposits with integrity. Therefore, the potential to encounter NRHP-eligible archeological sites within *Alternative A* is low. Still, this alignment would require further investigation of proposed new right-of-way that was not accessible or visible during the survey before construction. *Alternative A* would require approximately 0.12 acre of proposed right-of-way from the Forest Oaks Memorial Park (Cook Walden Cemetery); the proposed acquisition area does not include any gravesites and has been closely coordinated with Forest Oaks administrators.

Alternative C

Alternative C has moderate potential for surficial archeological sites due to the prevalence of such sites in Central Texas, although there is a low potential for them to contain deposits with integrity. Therefore, the potential to encounter NRHP-eligible archeological sites within *Alternative C* is low. Still, this alignment would require further investigation of proposed new right-of-way that was not accessible or visible during the survey before construction. *Alternative C* would require approximately 0.10 acre of proposed right-of-way from the Forest Oaks Memorial Park (Cook Walden Cemetery); the proposed acquisition area does not include any gravesites and has been closely coordinated with Forest Oaks administrators.

No Build Alternative

Under the *No Build Alternative*, there would be no impact to archeological or historic archeological sites.

Encroachment-Alteration Effects

No encroachment-alteration effects are anticipated as a result of the proposed project.

4.11.3 Historic Resources

This section summarizes the proposed project's affected environment and potential impacts on historic resources and culturally significant properties. Please see **Appendix L** for the *Report for Historic Resources Survey Report* for details regarding the methods and findings of the historic resources studies.

4.11.3.1 Existing Conditions

A reconnaissance survey was conducted to identify resources in the APE that are 45 years old or older (constructed prior to 1974), to evaluate the resources for NRHP eligibility, and to ascertain whether any resources warrant further study. Please see **Figure 4-18** for the location of the resources recommended as NRHP eligible.

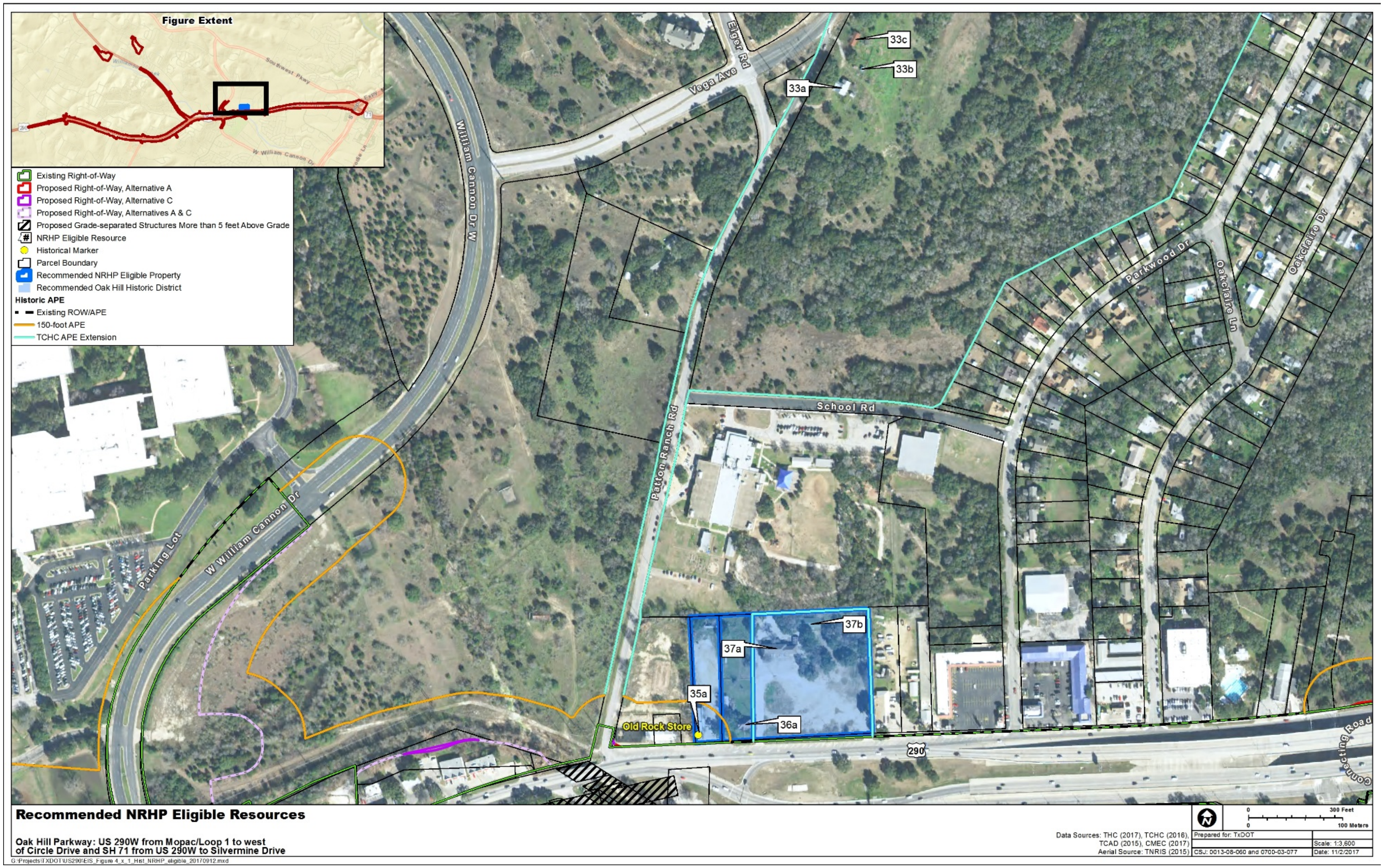

Figure 4-18. Historic resources recommended eligible for the NRHP.

4.11.3.2 Methods

A variable APE was established for the project, and is generally described as follows:

- existing right-of-way for at or below grade improvements within existing right-of-way
- 150 feet from proposed right-of-way and easements and in locations of grade-separated structures more than 5 feet above ground
- 300 feet from proposed right-of-way and easements in locations of stormwater detention ponds

In addition to the variable APE discussed above, the APE was expanded at TxDOT's request to encompass resources documented in the *Cultural Resources Survey and Assessment of Southwest Travis County, Texas* (available upon request at the Texas Historical Commission), located near the proposed project area. The survey was conducted by Preservation Central, Inc. in October 2015 for the Travis County Historical Commission (Preservation Central, Inc., 2015). Two additional properties were added to the current survey as a result of TxDOT's request. One property is located at 5612 Patton Ranch Road, north of US 290, and is known as the Patton Ranch Complex. The second property is located at 6240 W. US 290 and is the former Oak Hill School. All other resources documented in the Preservation Central, Inc. survey within the vicinity of the current project are encompassed in the APE established for the proposed project.

No existing NRHP-listed properties were identified within the APE. In all, 50 historic-age resources (constructed prior to 1974) located on 38 parcels were documented within the APE. Additionally, 39 non-historic-age resources associated with historic-age resources were documented in the inventory but were not described in the *Historic Resources Survey Report* (**Appendix L**). Of the inventoried resources, four are recommended individually eligible for NRHP listing. Additionally, one historic district, comprised of three of the individually eligible historic resources, is recommended eligible for NRHP listing. **Table 4-32** provides a summary of the resources recommended eligible for NRHP listing.

Table 4-32. NRHP-Eligible Historic Resources in the OHP Project APE

Unique Resource No.	Resource Type	Historic Property	Direct Effects	Indirect Effects	USDOT Section 4(f) Regulations 23 CFR 774 Applicable?
33a–c	Domestic	Patton Ranch: log cabin, agricultural outbuildings, and barn	No	No	No
36a	Domestic	Free Classic house (Patton-Enochs House)	No	No	No
35a	Commercial	Old Rock Store	No	No	No
37a–b	Education/School Resources	Oak Hill School	No	No	No

Unique Resource No.	Resource Type	Historic Property	Direct Effects	Indirect Effects	USDOT Section 4(f) Regulations 23 CFR 774 Applicable?
35a, 36a, 37a	District	Oak Hill Historic District: Old Rock Store, Patton-Enochs House, and Oak Hill School	No	No	No

Source: Project Team, 2017

4.11.3.3 Domestic Resources

The Patton Ranch (33a–c) was identified in the Travis County Historical Commission's 2015 survey as a high preservation priority as a rare example of a farmstead associated with pioneer settlement patterns. The original portion of the log cabin (33a), believed to have been constructed in 1870 by James. A. Patton, had wings added to the log cabin in the 1930s. Today, the complex consists of small agricultural outbuildings (33b) and a barn (33c). Although the house has been altered, the alterations occurred in the historic period and only slightly diminish integrity of design, materials, and workmanship. Integrity of setting and association are slightly diminished because the property is no longer used for agricultural purposes. However, the diminished integrity is not to such a degree the property can no longer convey its significance. Therefore, it is recommended eligible for NRHP listing under Criterion A in the area of Settlement and Exploration for its association with the earliest settlement of the Oak Hill area.

The Free Classic house, known as the Patton-Enochs House (36a), was identified as a high priority in the Travis County Historical Commission's survey as a unique example of its type and style in Oak Hill and is associated with the area's pioneer citizens and history. Alterations to the building, which are discussed in the *Historic Resources Survey Report* (**Appendix L**), only slightly diminish integrity of design, materials, and workmanship because they were completed in the historic period. However, integrity of setting has been substantially diminished due to the rapid development of the surrounding area in the second half of the twentieth century. Despite the diminished integrity, the house continues to convey significance. As such, this resource is recommended eligible for NRHP listing at the local level under Criterion A in the area of Community Planning and Development and under Criterion C in the area of Architecture. Research did not produce any evidence that the house rises to the level necessary to be NRHP eligible under Criterion B for its association with the Patton and Enoch families, early settlers of Oak Hill.

4.11.3.4 Commercial Resources

Known as the Old Rock Store (35a), this resource is designated as a Recorded Texas Historic Landmark (1970) and COA Landmark. Additionally, the resource is significant at the local level under Criterion A in the area of Commerce for its long history as a commercial building in Oak Hill. It is also significant under Criterion C in the area of Architecture as a good, local example of rustic limestone architecture from the late nineteenth century. It retains most aspects of integrity but has lost integrity of setting as the setting has been substantially altered over time with late twentieth-century development. However, the building continues to convey a strong sense of Oak Hill history. There is an associated storage building that is not historic-age and is considered non-contributing to the NRHP-eligible Old Rock Store.

4.11.3.5 Education/School Resources

The former Oak Hill School (37a–b)is designated as a COA Landmark. Additionally, it was identified as a high preservation priority in the Travis County Historical Commission's 2015 survey. Although its integrity of setting is diminished due to late-twentieth-century development in the area, and its integrity is diminished due to being vacant and no longer in use as a school, the building is recommended eligible for NRHP listing at the local level under Criterion A in the area of Education as an example of a rural, early twentieth-century school.

4.11.3.6 Historic Districts

Consideration was given to the presence of a potential historic district encompassing the resources associated with Oak Hill's early development period. The Patton Ranch (33a–c), the Old Rock Store/Austin Pizza Garden (35a), the Patton-Enochs House (36a), and the Oak Hill School (37a) reflect the residential, commercial, and educational building types of Oak Hill's early periods of development. The 1936 Travis County Highway Map indicates there were approximately a dozen buildings flanking US 290 near its intersections with Patton Ranch Road and McCarty Lane, as well as another half dozen buildings along Patton Ranch Road; collectively, these buildings formed the original core of the community of Oak Hill. Today, little more than the four resources identified above remain from Oak Hill's early periods.

Although all four buildings were considered as potential elements of a historic district, ultimately the recommended boundary for the historic district encompasses only the Old Rock Store/Austin Pizza Garden (35a), the Patton-Enochs House (36a), and the Oak Hill School (37a); the historic district does not include the Patton Ranch (33a–c), located approximately 0.5 mile north of US 290 on Patton Ranch Road. The intervening development along Patton Ranch Road, which is primarily the ca. 1975 Oak Hill Elementary School, has essentially severed the association between the Patton Ranch and the original core of the early Oak Hill community.

The three resources recommended for inclusion in the historic district represent most of the building types that comprised the early Oak Hill Community and represent part of the area's history that is rapidly disappearing. The grouping is recommended eligible for NRHP listing as the Oak Hill Historic District under Criterion A in the area of Community Planning and Development. The character-defining features of the historic district include the spatial organization of the contributing resources and each contributing resource's plan, form and architectural style; these characteristics make them immediately recognizable as representatives of three building types from Oak Hill's earliest periods of development. Oak Hill has long been a bustling crossroad community and has not been characterized as a quiet and serene place. Although integrity of setting and feeling have been diminished by the loss of other early Oak Hill buildings and the substantial suburban development that has occurred since the mid-twentieth century, the historic district retains sufficient integrity to convey its significance. As such, the Oak Hill Historic District is recommended eligible for NRHP listing at the local level under Criterion A.

4.11.3.7 Environmental Consequences

Build Alternatives

Direct and indirect visual, and noise impacts that could result from both *Build Alternatives* were considered. The *Build Alternatives* would pose no direct effects to historic properties identified in the historic resources survey (Resources 33a–c, 35a, 36a, and 37a) as no right-of-way would be acquired from any of the properties associated with the resources.

The proposed project would pose no indirect effects to the log cabin, agricultural outbuildings, and barn (Resources 33a–c) since they are located approximately 0.5 mile north of the proposed project area.

The proposed project would pose no adverse indirect effects to Resources 35a, 36a, and 37a, or to the NRHP-eligible Oak Hill Historic District. A study to assess potential indirect visual impacts was completed in accordance with TxDOT's *Standard Operating Procedure for Visual Impacts Assessment*. The setting and feeling of the historic properties and district have been substantially altered over time due to the development of the existing transportation corridor in the second half of the twentieth century. The proposed project would not introduce any new elements to the landscape. *Alternatives A* and *C* would pose no adverse indirect visual effects to the NRHP-eligible Resources 35a, 36a, and 37a, as neither *Build Alternative* would lessen the characteristics of each resource that convey their significance or alter characteristics of the historic resources that qualify them for inclusion in the NRHP.

Neither *Build Alternative* would create adverse indirect noise effects to the NRHP-eligible properties. The October 2017 *Noise Analysis Technical Report* and the July 11, 2017, *Supplemental Memo regarding Historic Properties* provide the foundation for the assessment of indirect noise impacts on historic properties. Table 4-33 summarizes the results of the traffic noise analysis, including Noise Abatement Criteria (NAC), existing noise levels, and predicted 2040 noise levels by alternative.

Table 4-33. Results of Traffic Noise Analysis dB(A) Leq

Resource ID	Activity Category/Noise Abatement Criteria (dB(A) Leq)	Existing Noise Level (2013)	2040 Predicted Noise Level—Alternative A	2040 Predicted Noise Level—Alternative C
35a	E-Restaurant/72 (exterior)	63	63	62
36a	B-Residential/67 (exterior)	74	72	71
37a	D-School/52 (interior)	38*	39*	39*

*The existing exterior noise level for Resource 37a was 63 dB(A), and the 2040 predicted exterior noise level for each alternative was 64 dB(A). An interior noise reduction factor of 25 dB(A), for masonry building type and single-glazed windows, was applied (*TxDOT Guidelines for Analysis and Abatement of Roadway Traffic Noise*, Table 5).

The traffic noise analysis indicates the existing and predicted noise levels for Resources 35a and 37a are below the NAC threshold and do not constitute an impact. Although the predicted noise level for Resource 37a would increase by 1 dB(A), this is not currently an existing impact nor will this be an impact in the future. For Resource 36a, the predicted noise levels for *Alternatives A* and *C* represent a decrease in the dB(A) from the existing level. However, the level would remain above the traffic noise impact threshold of 67 for a residence and constitute a noise impact. Therefore, consideration was given to noise abatement measures at this location. The traffic noise analysis indicates a noise barrier would be insufficient to achieve a minimum feasible reduction of 5 dB(A), and other noise abatement strategies would not be reasonable and feasible. Installation of a noise wall would also constitute an adverse visual effect under Section 106. Future noise levels expected with the construction of the project that are equivalent to, or lower than, the noise levels without the project would not constitute an adverse indirect effect under Section 106. The future noise levels would not lessen one's understanding of the resource's significance or alter characteristics of the historic resource that qualifies it for inclusion in the NRHP.

The proposed alternatives would pose no direct or adverse indirect effects to Resources 35a, 36a, 37a, or the proposed Oak Hill Historic District. Furthermore, no reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative were identified in the assessment of effects.

Since the proposed project would pose no direct or adverse indirect effects to the characteristics for which each NRHP-eligible property and district is significant, the U.S. DOT Act Section 4(f) regulations (23 CFR 774) do not apply to the proposed project.

No Build Alternative

Under the *No Build Alternative* for the OHP Project, additional right-of-way would not be acquired; therefore, no direct impacts to historic resources would occur. No indirect impacts would occur under the *No Build Alternative*.

Encroachment-Alteration Effects

Encroachment-alteration effects could include an increase in existing noise levels, visual impacts, or loss of access to a historic property, such that the encroachment-alteration effect diminishes the characteristics that cause a resource district to be historic. These indirect effects can alter the integrity of feeling or setting of historic properties.

However, the proposed project will have no encroachment-alteration effects because the it would have no direct effects and no adverse indirect effects on any of the NRHP-eligible resources or the historic district.

4.12 Hazardous Materials

4.12.1 Existing Conditions

A *Hazardous Materials Technical Report* was produced for the OHP Project and an initial site assessment (ISA) form was filled out documenting hazardous materials within the project corridor (Appendix M). The ISA including a visual survey of the existing right-of-way and surrounding area, and research into existing and previous land uses was performed by HDR Engineering to identify possible hazardous materials within the project limits. Documentation of the ISA is maintained in the Austin District project files.

Based on the site survey, the existing uses of land within the project limits and surrounding area include transportation right-of-way and a mosaic of commercial, residential, and institutional developments. A review of historic aerial photographs and topographic maps of the project area indicated that the “Y” in Oak Hill was developed between 1940 and 1953 (GeoSearch, 2015c, 2015d). Prior to its development as a roadway and the development of the myriad of land uses currently observed, the land appeared to have been used as ranchland/pasture or was undeveloped. Major residential development within the OHP Project area began in the 1970s, based on aerial photographs. Aerial photographs from 1940, 1953, 1966, 1973, 1980, 1988, 1996, 2004, and 2012 were reviewed. Topographic maps reviewed include:

- Austin, TX, 1:125,000—Years 1896 and 1910
- Oak Hill, TX, 1:24,000—Years 1966, photorevised 1973, 1986, and 2013
- Bee Cave, TX, 1:24,000—Years 1966, photorevised 1973, 1986, and 2013
- Signal Hill, TX, 1:24,000—Years 1968, photorevised 1973, 1988, and 2013

A site reconnaissance of the OHP Project area was conducted in February 2016 and focused on the roadway, proposed OHP Project right-of-way, and adjacent properties as viewed from the existing public right-of-way. Electrical transmission lines parallel portions of US 290, and overhead utility lines, an electrical substation, and pole-mounted transformers were present in the vicinity of the corridor. Evidence of underground storage tanks (USTs) were present at retail fueling facilities adjacent to the project corridor, and 55-gallon drums were observed behind a service station adjacent to the corridor. Minor solid waste dumping was observed near Williamson Creek. No wells, spills, odors, stressed vegetation, or other evidence of contamination were noted during the site reconnaissance.

4.12.1.1 Review of Federal, State, and Supplemental Databases

A regulatory database search was performed by GeoSearch on August 3, 2015, (GeoSearch, 2015a) and on January 20, 2016 (GeoSearch, 2016). The regulatory database lists reviewed include the National Priorities List (NPL), Texas State Superfund, Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS), Resource Conservation and Recovery Act (RCRA) facilities, municipal solid waste landfills (MSWLF), registered petroleum storage tanks (PST), aboveground storage tanks (ASTs) and USTs, and leaking petroleum storage tank (LPST) facilities. The *Hazardous Materials Technical Report*, included as **Appendix M**, contains a summary of the listings. Complete copies of the GeoSearch environmental database reports can be viewed in the project file.

A total of 190 records were identified in databases within the American Society for Testing and Materials (ASTM) search radius (GeoSearch, 2015a, 2016). Of those records, 16 sites (primarily LPST and Voluntary Cleanup Program [VCP] sites) were determined to have the potential to impact the project corridor. This determination was based on the type of database listing, the information provided in the database report, and the distance and direction of the listing to the corridor (these sites are described in **Table 4-34**). Twelve orphan or unlocatable sites were identified in the database search. One CERCLIS site was identified as an unlocatable site, the IMC Chemical Group. Homefacts.com plots the location of this site on US 290 between Oak Meadow Drive and Convict Hill Road. This site was archived by the EPA in 1980 meaning no further clean up action or investigation at the site is required.

Table 4-34. Sites of Greatest Environmental Concern

Site Information	Database	Location Relative to Project
Big Wheel Truck Stop [Map ID 1] 6517 W. Highway 290	LPST, PST, SPILLS Site Visit Concerns: None noted	Within existing right-of-way. Location of current Oak Hill Park & Ride facility. This facility had 10 registered ASTs which are reported as out of use. An LPST was reported in 1992; final concurrence has been issued by TCEQ and the case is closed. Two SPILLS were reported, one in 1992 (resulting in the LPST) and another in 1984.
Road and Bridge Office [Map ID 2] 6005 McCarty Lane	LPST, PST Site Visit Concerns: None noted	Within existing right-of-way. Two USTs were removed in 1990 and an LPST was reported in the same month. LPST resulted in soil contamination only which required a full site assessment and remedial action plan. Final concurrence has been issued and the case is closed.

Site Information	Database	Location Relative to Project
Exxon RAS 68497 [Map ID 4] 6820 W. Highway 290	LPST, PST, FRSTX, RCRANGR06, IHW Site Visit Concerns: None—Exxon is gone, and the site is now within TxDOT right-of-way.	Within existing right-of-way. Three USTs were removed in 1992, and an LPST was reported later the same month. LPST resulted in soil contamination only and required a full site assessment and RAP. Final concurrence has been issued and the case is closed. This site was listed as "Not a Generator" of waste and an inactive conditionally exempt small quantity generator.
AusTex Used Cars/TxDOT Right-of-Way [Map ID 6] 6812 W. Highway 290	LPST Site Visit Concerns: None—This facility is gone, and the former site is within TxDOT right-of-way.	Within existing right-of-way. LPST occurred prior to 2001 (date unknown). Final concurrence has been issued and the case is closed.
Country Grocery and Market [Map ID 8] 6850 W. Hwy 290	PST Site Visit Concerns: None noted	Within existing right-of-way. Three registered USTs were removed from the ground in 2003.
7-Eleven 25347 [Map ID 9] 6223 W Hwy 290	PST Site Visit Concerns: None noted	Within existing right-of-way. Three registered tanks were removed from the site in 1995.
Circle K 3276 (Speedy Stop) [Map ID 20] 7912 W. Highway 290	LPST, PST Site Visit Concerns: Active gas station	Within proposed right-of-way. An LPST was reported in 1987 with a groundwater impact; final concurrence has been issued and the case is closed. Speedy Stop is an active retail fueling facility with three registered USTs.
Circle K (Scenic Brook Food Mart—currently Exxon) [Map ID 23] 7136 Highway 71	LPST, PST Site Visit Concerns: Active gas station	Adjacent to the east. An LPST with groundwater impacts was reported in 1984. Final concurrence has been issued and the case is closed. One active tank was registered at this location.
Cedar Valley Central Office [Map ID 24] 8900 Circle Drive	LPST, PST Site Visit Concerns: None noted	630 feet north of proposed right-of-way. One UST is registered at this location. An LPST was reported in 1992 resulting in minor soil contamination with no remedial action required. Final concurrence has been issued and the case is closed.
ACC Pinnacle Annex [Map ID 35] 7748 Highway 290 West	VCP Site Visit Concerns: None noted	300 feet north of right-of-way. The campus applied for the VCP in 2009 for soils potentially impacted by heavy metals. Case is listed as in the investigation phase.
290 Location [Map ID 1b] Boston Lane	LPST, PST Site Visit Concerns: None noted	Adjacent to north side of right-of-way. Three USTs were removed from this location in 1990 and an LPST was reported which resulted in soil contamination only. Final concurrence and site closure were reported in 1990.

Site Information	Database	Location Relative to Project
A Tex Pools [Map ID 8b] 5258 Highway 290 W.	LPST, PST Site Visit Concerns: None noted	Adjacent to north side of right-of-way. Three USTs were removed in 1992 and the PST registration is inactive. The LPST resulted in soil contamination only. Final concurrence and case closure were reported in 1993.
Austin Twinbrook 892 CO [Map ID 8b] 5240 Highway 290 W.	LPST, PST Site Visit Concerns: None noted	Adjacent to north side of right-of-way. One active AST is registered at this location and one UST was removed in 2002. The LPST resulted in minor soil contamination; final concurrence was issued, and the case was closed in 1992.
Road Runner Lube/ TxDOT Right-of-Way [Map ID 11b] 5199 W. Highway 290	LPST, PST Site Visit Concerns: None noted	Within existing right-of-way. One UST was removed in 1992 and PST registration is inactive. The LPST did not impact groundwater and final concurrence was issued and the case was closed in 1992.
Polk Feed/Former Polk's Feed Store [Map ID 16b] 5610 W. Highway 290	LPST, PST Site Visit Concerns: None noted	Adjacent to north side of right-of-way. This site is inactive in the PST database for four USTs which were removed in 1996. An LPST was reported in 1995. Final concurrence has been issued, and the case is closed.
Pro-Ed [Map ID 19b] 5341 Industrial Oaks Boulevard	LPST, PST Site Visit Concerns: None noted	422 feet north of right-of-way. This site was listed as inactive in the PST database. One UST was removed in 1990. An LPST was reported in 1990, resulting in soil contamination only. Final concurrence has been issued, and the case is closed.

Source: Project Team, 2017

4.12.2 Environmental Consequences

As mentioned previously, the *Hazardous Materials Technical Report* for the OHP Project is included as **Appendix M**. This report includes a list of the regulatory databases reviewed, brief summaries of the sites, and maps identifying the locations of sites. As shown in **Table 4-34**, several sites listed in the database reports were determined to have potential to impact the project corridor based on the type of database listing, the information provided in the database report, and the distance and direction of the listing from the corridor. HDR recommends further analysis of potential sites of concern and that the location of these sites should be considered during the preliminary design phase. The depth to groundwater should be determined for locations where construction is proposed to occur to determine the likelihood of reaching groundwater and to determine whether contaminants held in the groundwater would be likely to impact construction.

4.12.2.1 Alternative A

Alternative A would require the acquisition of approximately 74.58 acres of new right-of-way. In addition to small slivers of property along the existing facility, the acreage also includes acquisition of one residential and four commercial properties. Of particular concern for acquisition is the Speedy Stop gas station and convenience store (Circle K 3276) which was listed in the PST and LPST databases. The LPST case at the Speedy Stop resulted in a groundwater impact, but final concurrence has been issued and the case is closed. It is anticipated that contaminated soil and/or groundwater could be encountered during construction. Special provisions or contingency language would be included in the project's plans, specifications, and estimates (PS&E) to handle hazardous materials and/or petroleum contamination according to applicable federal and state regulations.

An ASTM-conforming Phase I environmental site assessment is recommended prior to any property acquisition (ASTM, 2015). Since the OHP Project requires acquisition of substantial portions of commercial properties, additional environmental assessment would be warranted. Property assessment should be in accordance with applicable ASTM standards to the extent practical in consideration of the highway right-of-way acquisition/eminent domain process.

The OHP Project includes the demolition of building structures. The buildings may contain asbestos-containing materials. Asbestos inspections, specification, notification, license, accreditation, abatement, and disposal, as applicable, would comply with federal and state regulations. Asbestos issues would be addressed during the right-of-way acquisition process prior to construction.

Construction contractors should be instructed to immediately stop all subsurface activities in the event that potentially hazardous materials are encountered, an odor is identified, or significantly stained soil is visible. Contractors and maintenance personnel should be instructed to follow all applicable regulations regarding discovery and response for hazardous materials encountered during the construction process.

4.12.2.2 Alternative C

Alternative C would require the acquisition of approximately 75.19 acres of new right-of-way. Impacts would be the same as those listed for *Alternative A*, including the acquisition of one residential and four commercial properties.

4.12.2.3 No Build Alternative

With the *No Build Alternative*, no construction or property acquisition associated with the project would occur. Therefore, no impacts to hazardous materials would be anticipated.

4.12.2.4 Encroachment-Alteration Effects

Encroachment-alternation effects are those that result from changes in ecosystems, natural processes, or socioeconomic conditions due to the proposed action. Hazardous materials are not considered in this category; therefore, encroachment-alternation effects in relation to hazardous materials would not occur.

4.13 Visual and Aesthetic Resources

Highways and major transit facilities can affect the visual and aesthetic character of surrounding landscapes and the perceptions of individuals who live within and visit these environments. The 2015 FHWA guidance, *Visual Impact Assessments of Highway Projects*, provides a framework for evaluating impacts to visual and aesthetic resources for highway projects (FHWA, 2015). The National Cooperative Highway Research Program (NCHRP) issued a report entitled *Evaluation of Methodologies for Visual Impact Assessment* in 2013 (Transportation Research Board, 2013). The methodology for this analysis used these resources to describe existing visual character and quality and existing viewer exposures and sensitivity in the project area. This section includes an analysis of changes in visual resources and anticipated viewer responses to determine potential visual impacts of the proposed *Build Alternatives A* and *C* and the *No Build Alternative*. See the *Visual and Aesthetic Resources Assessment Technical Report* in **Appendix N** for more on the methodology, images, and renderings used in this analysis.

4.13.1 History of Stakeholder Involvement

The design and corresponding visual impacts of *Alternatives A* and *C* are a product of years of stakeholder involvement, including the incorporation of an approach called CSS. CSS is a collaborative approach to transportation design and engineering that involves stakeholders in the process of developing a solution appropriate for its setting in order to preserve and enhance local scenic, aesthetic, historic, and environmental resources (Oak Hill Parkway, 2014). The project team's intent in using this approach was to create a safe, efficient, and environmentally responsible transportation corridor that is appropriate for its setting and speaks to the needs and values of the surrounding community (Oak Hill Parkway, 2017a). As a result of multiple stakeholder workshops focused on CSS, the vision for the OHP Project was developed to improve traffic flow and capacity on the corridor and provide new mobility options for pedestrians, bicyclists, and drivers without sacrificing the quality of life in Oak Hill.

Stakeholders agreed that corridor improvements should preserve Oak Hill's highly valued natural character, with particular focus on Williamson Creek and the area's cherished oaks. Aesthetic improvements should be respectful of the area's existing context and should utilize natural materials and sustainable technologies. Top community priorities included enhancing pedestrian and bicycle mobility, using local materials, conserving natural resources, providing lighting for aesthetics and safety, enhancing water quality through the use of natural water quality controls, and incorporating landscaping into the corridor (Oak Hill Parkway, 2017a). To see exhibits representing CSS designs, see *Appendix B: Key Observation Point Site Photos* in the *Visual and Aesthetic Resources Assessment Technical Report*, August 2017 in **Appendix N**. This report includes plan-view renderings demonstrating how the CSS approach could be incorporated into the design of the project through such strategies as the preservation of existing trees, the planting of low-maintenance native grass and native shade trees, a shared-use path that travels alongside Williamson Creek, and the use of natural materials for proposed structures. Further CSS outreach is expected to continue into 2017.

Additionally, the Mobility Authority, in partnership with TxDOT, launched the Green Mobility Challenge in 2011. This was a sustainable design competition that challenged landscape architects, planners, and engineers to propose better ways of constructing and maintaining future transportation projects, one of which was the OHP Project. Ideas submitted as part of the challenge have been evaluated and added to the environmental study where feasible, including the use of multi-use trails, native and low-maintenance vegetation, porous pavement, grass filter strips, vegetated swales, regional detention/biofiltration, and solar pedestrian lighting (Oak Hill Parkway, 2017b).

4.13.2 Method

Build Alternative sites are within an urbanized transportation corridor near the furthest southwest limits of the COA. The OHP Project area has been organized into unique landscape units (LUs) defined by their similar visual features and homogeneous character (**Figure 4-19** and **Figure 4-20a–c**). An analysis of impacts to visual and aesthetic resources of each LU has been conducted in accordance with the *Guidelines for Visual Impact Assessment of Highway Projects* (FHWA, 2015). Impacts were evaluated using on-site images, renderings depicting *Build Alternatives*, and conceptual design plans and profiles (**Appendix N**). Impacts within LUs were assessed using key observation points (KOPs), which provide representative examples of available views of *Build Alternative* sites and their associated viewsheds (see **Appendix N**).

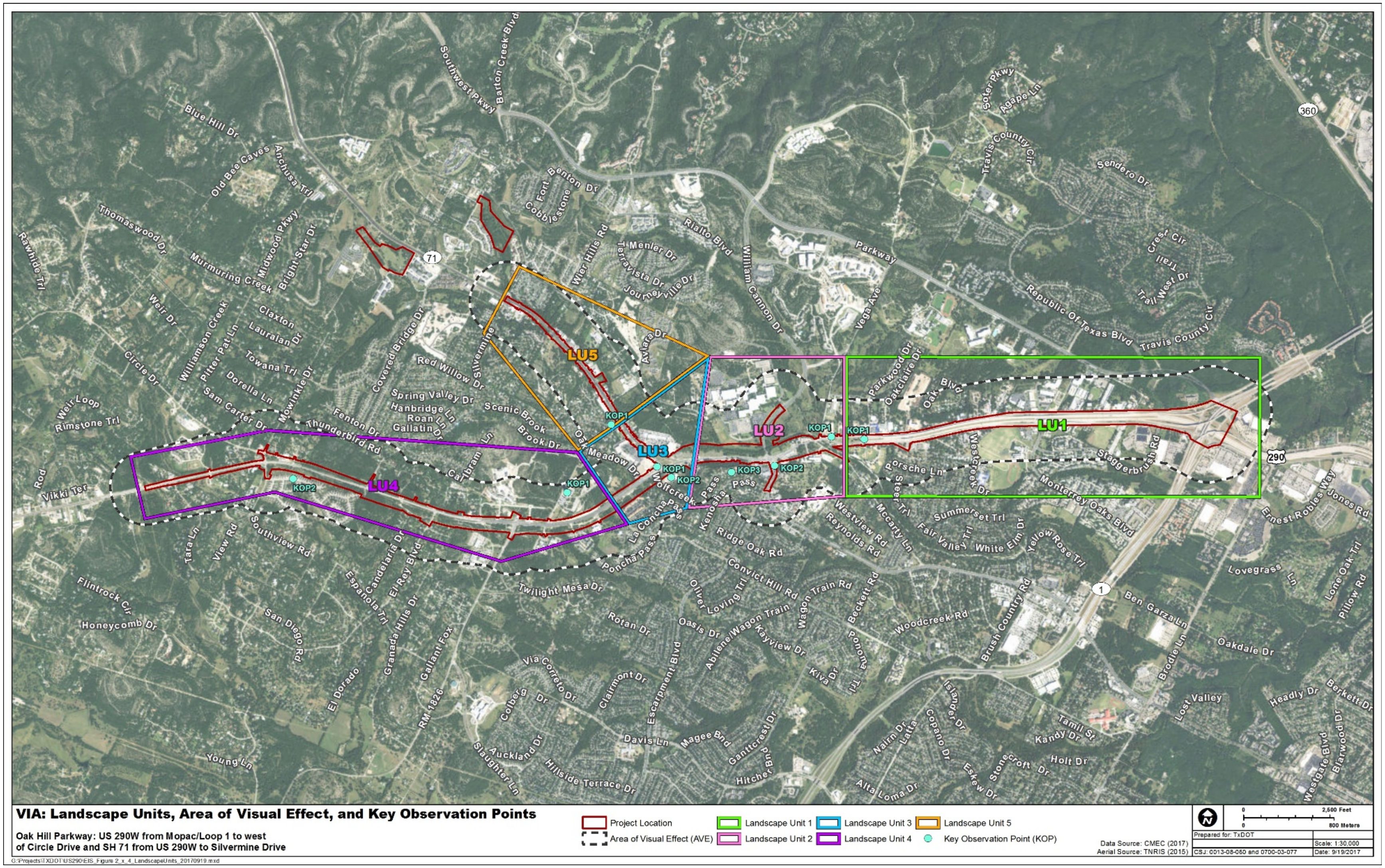

Figure 4-19. Visual impact assessment landscape units, area of visual effects, and key observation points.

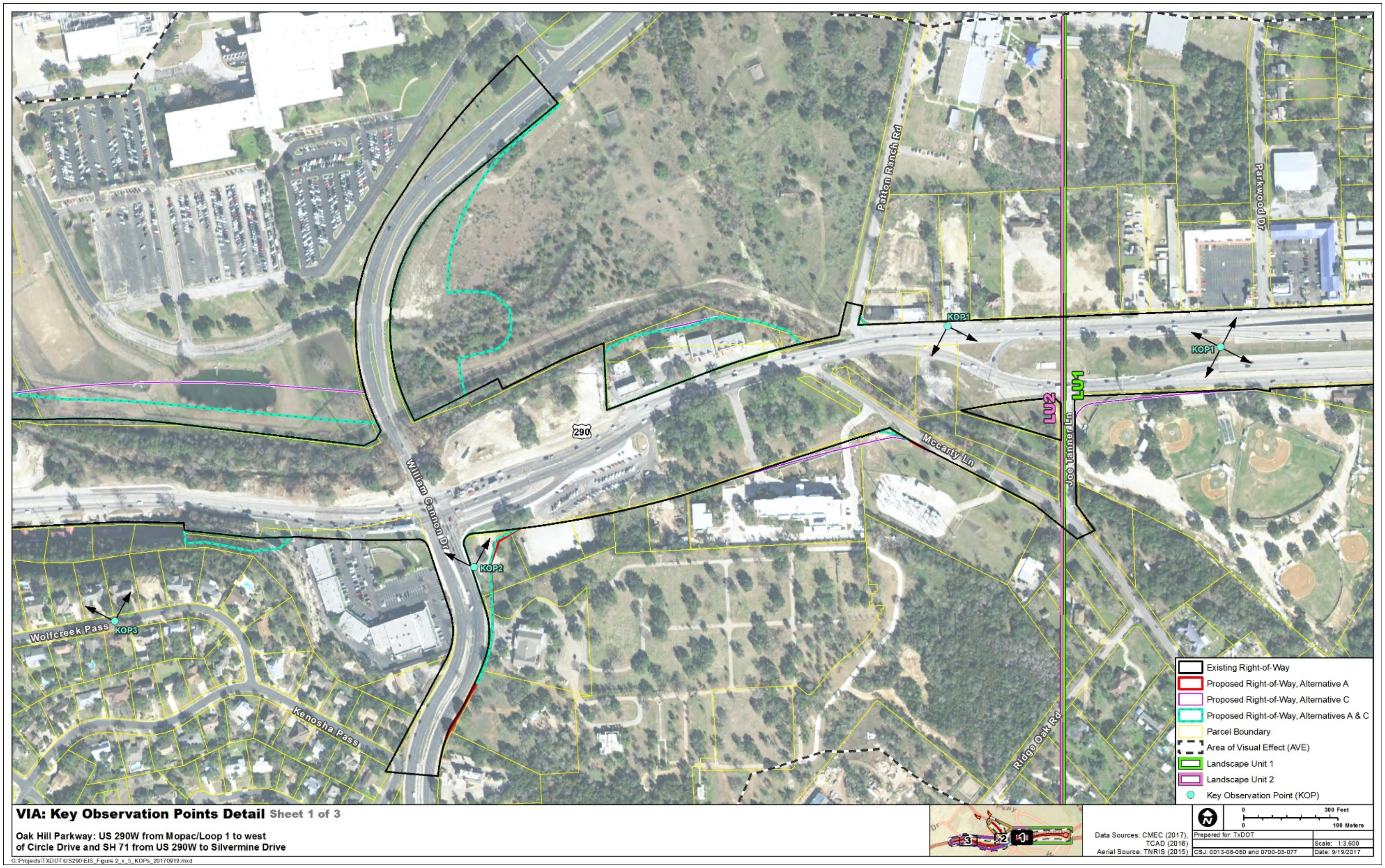

Figure 4-20a. Visual impact assessment key observation points, detailed view.

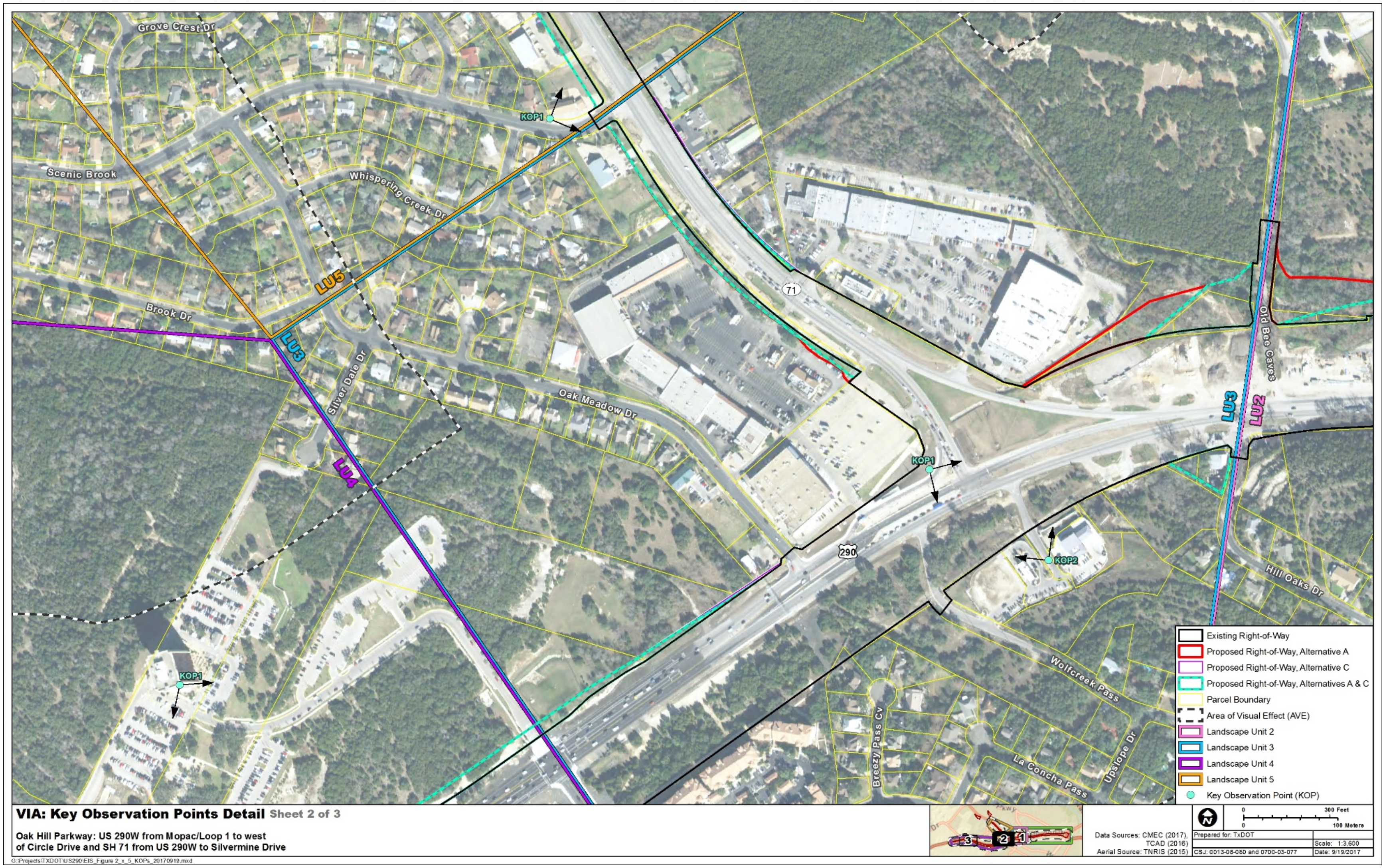

Figure 4-20b. Visual impact assessment key observation points, detailed view.

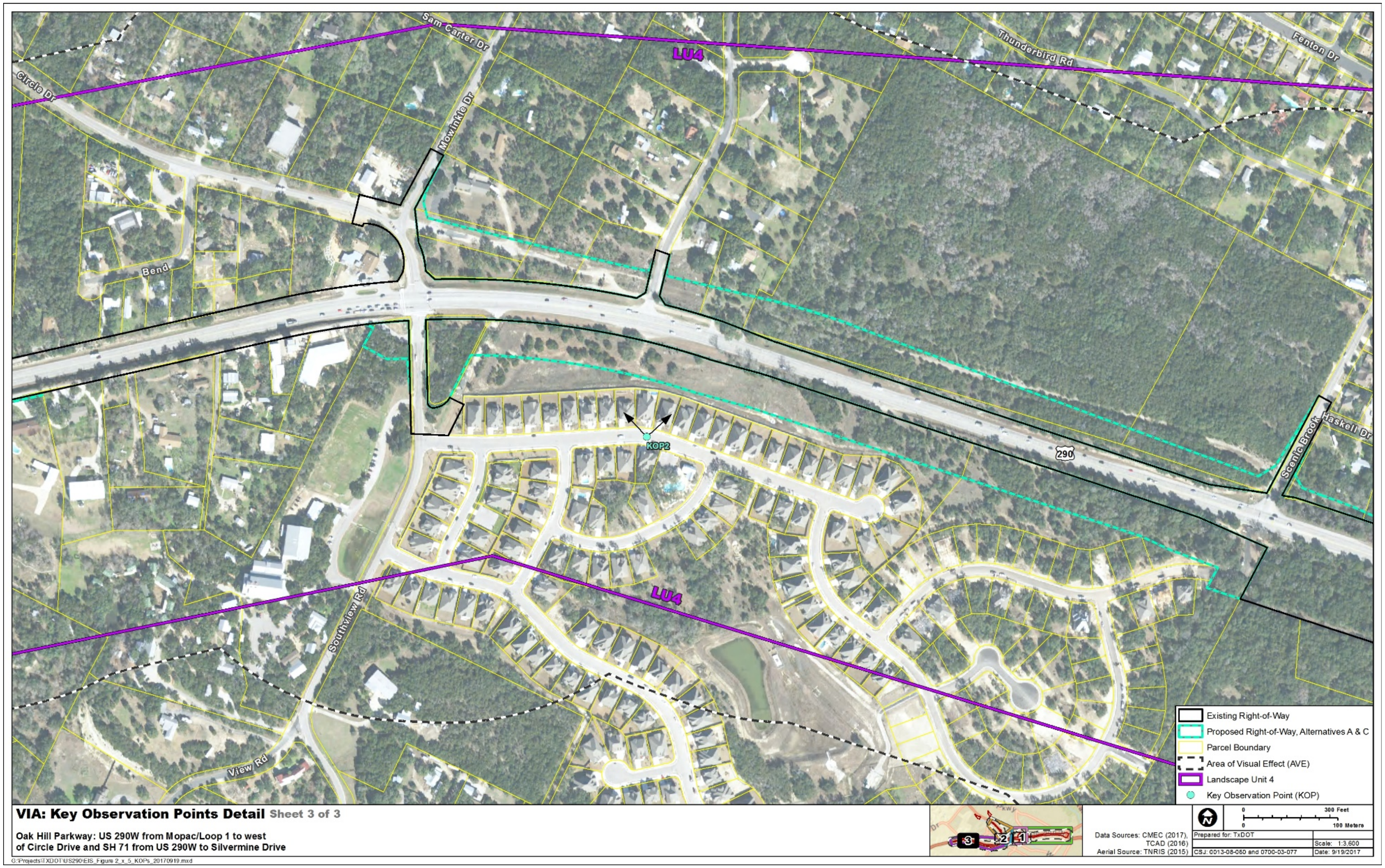

Figure 4-20c. Visual impact assessment key observation points, detailed view.

KOPs were established to represent the most sensitive views in the project area, based on number of viewers, length of time a typical observer would see the view, and proximity of viewers to elements of the *Build Alternative*.

4.13.3 Affected Environment

4.13.3.1 Landscape Unit 1: MoPac to Joe Tanner Lane

The physical geography of LU 1 is characterized by relatively flat rolling terrain. This LU is developed with large retail commercial operations typical of commercial developments adjacent to high-volume transportation corridors, but the area also supports uses such as a middle and elementary school campus along US 290 frontage roads. The three-level stacked interchange at US 290/SH 71 and MoPac is the dominant visual feature in this LU. The portion of US 290/SH 71 from MoPac to the area just west of Old Fredericksburg Road is a six-lane urban freeway (three lanes in each direction) with grade-separated interchanges. The US 290/SH 71 mainlanes are 12 feet wide with 10-foot-wide shoulders; frontage road lane widths vary from 12 to 14 feet wide. Mainlanes are elevated over the intersections at Monterey Oaks Boulevard and Old Fredericksburg Road. Frontage roads in this section consist of four to eight lanes (two to four lanes in each direction). Between Old Fredericksburg Road and Joe Tanner Lane, US 290/SH 71 transitions from a freeway/frontage road facility to a four- and five-lane urban highway, where lanes are 11 to 12 feet wide and include an intermittent 12-foot-wide center left-turn lane.

For a traveler on US 290, the visual character of the natural environment of this LU is characterized by open sky views framed by dense wooded areas, intermittent street trees, and highway lighting units. Rooftops, pole signs, and billboards are visual elements composing the built environment when traveling on the elevated segments of US 290. When traveling east on US 290 approaching the interchange, travelers have a view of rolling hills and the downtown Austin skyline in the background. The visual character of the cultural environment of this LU is moderate. At the US 290/MoPac interchange, there is a coalescence of suburban commercial land use developments, some oriented to collector streets and others oriented to frontage roads. This creates an inconsistent visual texture where the expanses of parking lots are broken up by buildings situated in the rolling topography and divided by a high-capacity road network. Many of the residential, commercial, and recreational areas in this LU are well maintained and have a sense of cultural order, but the vividness of this LU is low, and there are few memorable, dramatic, or distinctive visual resources. The overall visual quality of this LU is moderate.

4.13.3.2 Landscape Unit 2: Joe Tanner Lane to Old Bee Cave Road

The physical geography of the eastern part of LU 2 is characterized by relatively flat rolling terrain. Just west of William Cannon Drive, the limestone face of the bluff extends up from the ground surface to an elevation of approximately 940 feet amsl. While the vertical face of the bluff varies in height, in general it stands approximately 100 feet above the grade of the existing transportation corridor. The bluff and its vegetation along the south side of US 290 are defining components of the natural environment in LU 2. Within this LU, US 290/SH 71 is a four- and five-lane urban highway with a mix of curb and gutter and roadside ditch drainage features. Travel lanes are 11 to 12 feet wide and include an intermittent 12-foot center left-turn lane. This LU is mostly developed with older, smaller-scale highway commercial businesses. A large technology corporate campus with formal landscaped grounds is located north of US 290, mostly screened from the OHP Project area by topography and a vegetated buffer of mature trees. Located south of the technology campus but north of US 290 in existing TxDOT right-of-way are four trees that were identified as iconic community trees in a series of public meetings for the project (see **Section 7**, Public and Agency Involvement). Williamson Creek runs under US 290/SH 71 just west of Patton Ranch Road.

The visual character of the natural environment of this LU is characterized by the bluff and densely vegetated areas scattered about in the LU, including the vegetation running parallel to Williamson Creek. Other components of the natural environment are the iconic trees located in a swath of right-of-way north of US 290 at the William Cannon Drive intersection and at the Williamson Creek crossing of US 290 at the Patton Ranch Road terminus. The visual character of the natural environment is high.

Commercial nodes, developed over the decades to support a range of commerce, are separated by the visual open space of surface asphalt parking lots and vegetation running parallel to the transportation corridor with little formal organization. One of the Oak Hill area's earliest structures, the "Old Rock Store" north of US 290 (Austin Pizza Garden), sits just south of a non-descript strip mall. While LU 2 has structures that help define the cultural environment of Oak Hill, the comprehensive character of the cultural environment is low. The overall visual quality of this LU is moderate.

4.13.3.3 Landscape Unit 3: The "Y" Interchange (Old Bee Cave Road to Scenic Brook Drive and Convict Hill Road

The physical geography of LU 3 is characterized by relatively flat rolling terrain with the densely vegetated hillside framing the visual background in the northwest, northeast, and southern viewsheds. In the immediate view, the bluff protrudes upward from the grounds on the south side of the existing transportation corridor, supporting some newer small-scale commercial developments which have incorporated interesting architectural elements. The visual character of the natural environment of this LU is characterized predominantly by the stand of trees along the south side of US 290 within existing TxDOT right-of-way along the bluff and the densely vegetated hillsides in the background. Other memorable natural elements in this area are limited. The visual character of the natural environment within the foreground of the LU is moderate, but beyond in the visual background looking south, the character is high.

This LU is developed with retail operations. Asphalt parking lots and TxDOT right-of-way serve as visual open space interrupted by the bulk and mass of large commercial retail stores and their associated signage. The dominant visual feature in the area is not the spatial relationship of the buildings to the landscape and infrastructure, but signs serving to announce operations within the structures and direct patrons to services. Visual symbols of signage (pole and wallmounted) are the most commanding visual force of the cultural environment in this LU. A large billboard with a message for Powerball and Mega Millions Lottery (immediately adjacent to Prosperity Bank) rising upwards from the top of the bluff is one of the most memorable features of the built environment. The visual character of the cultural environment is low. While the rolling hills outside of the LU provides a vivid visual background, the overall visual quality of this LU is moderate.

4.13.3.4 Landscape Unit 4: Convict Hill Road to Tara Lane

The physical geography of LU 4 is visually expressed by the open sky and rolling terrain of the Hill Country. This LU is developed with less intensity than other segments of US 290 in the OHP Project area; several areas along this part of the corridor are undeveloped. In this LU, the US 290 roadway consists of four 12-foot-wide lanes with turn lanes and 2-foot-wide shoulders.

Stands of mature trees, grasslands, and the limestone face of the bluff are memorable features of this LU, which provides a view of the densely wooded hillside when heading west. The visual character of the natural environment of this LU is moderate to high. Development along the corridor is generally buffered from sight by large swaths of mature trees. The cultural environment of this area is in part defined by the ten-story ACC Pinnacle campus building. This tower is the tallest building in southwest Austin, standing approximately 56 feet above nearby US 290 and 985 feet amsl, about 500 feet higher than downtown Austin. ACC moved into the building in 1991; the cafeteria on the ninth floor provides views of downtown (approximately 9 miles to the east). The visual character of the cultural environment of this LU is high. The overall visual quality of this LU is moderate to high.

4.13.3.5 Landscape Unit 5: Scenic Brook Drive to Silvermine Drive

The physical geography of LU 5 is characterized by relatively flat, gently rolling topography. This LU is sparsely developed with smaller commercial properties separated by large swaths of undeveloped vegetated land. The existing SH 71 facility is a four-lane rural highway with two signalized intersections and left-turn lanes which provide access to commercial and residential land uses on both sides of the roadway. Lane widths are 12 feet with 2- to 4-foot-wide shoulders within this area. A 12-foot-wide center turn lane exists from the shopping center drive to south of Scenic Brook Drive.

The visual character of the natural environment of this LU is defined by mature stands of trees that line the corridor, interrupted by occasional low-intensity commercial development and views of forested hillsides in the distance. Some of the commercial developments preserved trees, while other developments removed all existing vegetation and have limited landscaped environments. The visual character is moderate. The area’s transition from an agricultural community to a suburban community at the edges of the COA is reflected in the cultural environment of this LU. Small commercial nodes of different development periods are separated by vegetated open space running parallel to the transportation corridor with little formal organization. The cultural environment of this LU is moderate to low. The overall visual quality of this LU is moderate to low.

4.13.4 Environmental Consequences

Visual impacts were evaluated based on professional judgment and simulated views to predict viewer groups' perceptions of the change to the environment. KOPs for each LU were chosen to analyze views where it was perceived that communities, especially the Oak Hill community, would be most sensitive to change. The extent of potential impact is based on compatibility of the impact, viewer sensitivity to the impact, and degree of the impact. Simulated views of the *Build Alternatives*, a detailed discussion of the methodology for this analysis, and impacts per alternative are provided in **Appendix N**: *Visual and Aesthetic Resources Assessment Technical Report* (September 2017).

4.13.4.1 Landscape Unit 1: MoPac to Joe Tanner Lane

Alternative A

From the easternmost point of the project area to Parkwood Drive, work would be limited to an overlay of existing travel lanes. To the west, new construction of reconfigured at-grade travel lanes would occur. The transportation corridor would be reconfigured in this area, but traffic lanes would not be elevated; the degree of change would be neutral, having a low impact to existing visual resources.

Alternative C

Like *Alternative A*, work from the easternmost point of the project area to Parkwood Drive would be limited to an overlay of existing travel lanes. From this location to Joe Tanner Lane, new construction of reconfigured at-grade travel lanes would occur. While the reconfiguration of travel lanes east of Joe Tanner Lane is slightly different than work associated with *Alternative A*, travel lane modifications associated with *Alternative C* would also be at-grade in this LU. The degree of change would be neutral, having a low impact to existing visual resources.

4.13.4.2 Landscape Unit 2: Joe Tanner Lane to Old Bee Cave Road

Alternative A

From Joe Tanner Lane to west of Patton Ranch Road, traffic lanes would be reconfigured and remain at-grade. Landscape improvements, including trees and turf, would serve to help better organize the existing transportation corridor in front of the Old Rock Store building (Austin Pizza Garden). US 290 mainlanes would transition to elevated west of Patton Ranch Road. The elevated US 290 mainlane crossings (on columns) over William Cannon Drive would be at an elevation similar to existing tree tops north and south of US 290, helping to visually incorporate the US 290 structure into the natural environment.

West of William Cannon Drive, US 290 would be constructed north of Williamson Creek, and the elevated structure would largely be buffered from view due to existing vegetation (to the south) and topography and development patterns (to the north). Eastbound US 290 elevated mainlanes would be located immediately north of the Oak Hill Centre surface parking lot at the southwest corner of US 290 and William Cannon Drive. While the elevated structure would be a prominent feature of the built environment at this location, viewer groups have low sensitivity and are not anticipated to be visually impacted by the project.

As the eastbound elevated mainlanes continue west past the Oak Hill Centre, the mainlanes would be located parallel to a single-family residential district on the south side of the transportation corridor. Wolfcreek Pass, a residential street atop the bluff where the rear yards of single-family homes overlook the existing transportation corridor, is the location where residents may have a high sensitivity to visual changes. Visual impacts from the rear yards of homes on the north side of Wolfcreek Pass are anticipated to be moderate. The elevated US 290 mainlanes would be developed approximately 20 to 40 feet below the elevation of the rear yards of single-family homes along the northside of Wolfcreek Pass and approximately 100 feet to the north, putting the south face of the elevated mainlane in the foreground of the existing view. LU 2 has a moderate visual quality, and the project would integrate the transportation infrastructure with the natural and cultural environment, resulting in a moderate degree of change.

Alternative C

The introduction of elevated mainlanes within the existing transportation corridor would result in a high degree of change in the small commercial area where the Old Rock Store Building (Austin Pizza Garden) is located, just east of Patton Ranch Road. The elevated mainlanes, located between frontage roads, would be at a higher elevation than the existing commercial structure (Austin Pizza Garden) with mainlanes supported by a solid retaining wall. Patrons are the primary viewer group and would typically not be visually impacted by the panelized concrete retaining wall, as the existing visual environment is composed of a generous swath of asphalt at-grade roads and a paved median in the foreground. The elevated mainlanes of US 290 are planned north of the at-grade frontage roads, approximately 300 feet north of the rear yard of homes on Wolfcreek Pass, placing the mainlanes further from the residences. Parts of the elevated structure would be obscured to viewer groups by existing vegetation and planned landscape improvements.

4.13.4.3 Landscape Unit 3: The "Y" Interchange (Old Bee Cave Road to Scenic Book Drive and Convict Hill Road)

Alternative A

The US 290 mainlanes would transition to depressed lanes with frontage roads at approximately the existing grade. The introduction of elevated SH 71 direct connector ramps to the existing transportation corridor would create a low visual impact in an area of low visual quality. The highest elevation of the connector ramps, approximately 25 feet from existing grade, would be in close approximation to the roof of the large retailer (H-E-B) currently occupying the space at the northeast corner of the US 290/SH 71 intersection. These elevated lanes continue just north of Scenic Brook Drive. With US 290 below grade, views from the north and south are not obstructed. Landscape trees and a shared-use path would be introduced into the built environment along the SH 71 corridor. The rolling hills to the south of the project corridor serve as the dominant background. The transportation corridor would evolve from a loosely organized area of surface interchanges into an organized transportation network (elevated, at-grade, and below grade lanes) serving a broad range of users (including pedestrians and bicyclists). Therefore, *Alternative A* would enhance the visual quality of this unit where the existing visual quality is currently moderate to low.

Alternative C

Like *Alternative A*, elevated SH 71 direct connector ramps would be introduced to the existing transportation corridor; however, US 290 mainlanes are designed to be elevated until just east of Oak Meadow Drive at the same approximate height of SH 71 (25 feet). The US 290 elevated lanes would taper down to approximately 17 feet below the Convict Hill Road crossing. Like *Alternative A*, the transportation corridor would evolve from a loosely organized area, but the collective elevated components would create a large bulk/mass over the existing transportation corridor. North and south views of the face of the bluff and rolling hills would be obstructed from pedestrians and bicyclists using the shared-use path system associated with the project. The design of *Alternative C* in this LU would frame two sides of the "Y" with both frontage and elevated roads that would serve as visual barriers to the rolling hillside in an area designated as a future town center (see **Section 4.2 Land Use**). The collective bulk and mass of the elevated roadways associated with the design of *Alternative C* would degrade visual quality in LU 3.

4.13.4.4 Landscape Unit 4: Convict Hill Road to Tara Lane

Build Alternatives

Heading west from Convict Hill Road, US 290 is generally located at or below the grade of the existing transportation corridor travel lanes. The project would have a low degree of change in this area. No single part of the transportation project would dominate the views, and the visual components of *Alternatives A* and *C* are generally within the limits of the existing transportation corridor and are not distinct from each other. Visual impacts would be low.

4.13.4.5 Landscape Unit 5: Scenic Brook Drive to Silvermine Drive

Build Alternatives

Both of the *Build Alternatives* would have similar impacts, as the project design is the same in this LU. The project would have a low degree of change in this area. No single part of the transportation project would dominate the views, and the visual components of *Alternatives A* and *C* are generally within the limits of the existing transportation corridor. Visual impacts would be low.

4.13.4.6 No Build Alternative

The *No Build Alternative* would not change the existing visual and aesthetic qualities in the LUs. The US 290/US 71 corridor, along with the adjacent built and natural environments, would continue to be a local visual landmark and serve as the primary transportation corridor in the area.

4.13.5 Conclusion

4.13.5.1 Build Alternatives

Build Alternatives are the culmination of a design and public involvement process that has been ongoing since 2012, and opportunities have been identified to maximize compatibility with the existing built and natural environment. The structural design was developed through CSS and robust stakeholder involvement to be compatible with the surrounding natural and cultural environment and to minimize visual impacts.

In general, the visual impacts of both alternatives are neutral; however, in LU 3, *Alternative C* would degrade visual quality because of the collective bulk and mass of the elevated roadways in relation to topography and existing land development patterns in this LU.

4.13.5.2 No Build Alternative

Under the *No Build Alternative*, the proposed project would not be built. Future population and employment growth are assumed to occur as described in adopted plans, but without the proposed project, visual quality within the region may incrementally change consistent with existing trends as a result.

4.13.5.3 Encroachment-Alteration Effects

No encroachment-alteration effects are anticipated as a result of the proposed project.

4.14 Energy Impacts

FHWA Technical Advisory T 6640.8A provides guidance on addressing energy impacts in NEPA documents (FHWA, 1987).

4.14.1 Build Alternatives

Both the construction and operational energy requirements of *Alternatives A* and *C* were considered. As the project length would not vary, the energy needed to construct the proposed OHP Project would be expected to be similar for each of the *Build Alternatives*.

Roadway traffic would likely be the largest contributor to energy consumption over the lifetime of the OHP Project. Completion of the proposed OHP Project would compensate for the energy used during construction. By decreasing congestion, increasing the system connectivity, and diverting cut-through traffic from neighborhood streets and onto the new faster-flowing facility, the proposed OHP Project would increase energy efficiency over current and *No Build* conditions. The proposed OHP Project is consistent with the Federal Energy Policy and Conservation Act.

The proposed OHP Project would increase system connectivity, decrease travel times, and ease congestion along the US 290/SH 71 corridor and in nearby areas. Therefore, the long-term operational energy savings would offset any initial construction energy use.

4.14.2 No Build Alternative

Under the *No Build Alternative*, the proposed OHP Project would not be built, which would not result in any construction-related energy consumption in or around the study area. However, congestion would continue to increase on existing US 290, SH 71, and the local arterial roadways, and travelers would not have any additional roadway options to accommodate travel within the study area and larger region. The lack of travel options would lead to longer travel times and increased energy consumption in and around the study area when compared to either of the *Build Alternatives*.

4.15 Greenhouse Gas and Climate Change

Climate change relates to transportation in two ways. First, transportation emissions may contribute to climate change (U.S. Global Change Research Program [USGCRP], 2014); second, the changing climate has the potential to affect the transportation system (EPA, 2017). Because climate is a global issue (United Nations, 2017), it is difficult to examine on an individual project level. Therefore, TxDOT has prepared a statewide *Greenhouse Gas and Climate Change Technical Report* (Appendix O), which includes a climate change assessment, a description of how TxDOT is responding to a changing climate, and a greenhouse gas (GHG) analysis for the entire on-road transportation system in Texas. A summary of the findings of the statewide climate change assessment and GHG analysis are provided below; refer to the technical report for more details.

The Earth has gone through many natural changes in climate over time. Since the industrial revolution began in the 1700s, atmospheric concentration of GHG emissions have continued to climb, primarily due to humans burning fossil fuels (e.g., coal, natural gas, gasoline, oil, and/or diesel) to generate electricity, heat and cool buildings, and power vehicles. According to the Intergovernmental Panel on Climate Change (IPCC), this increase in GHG emissions is projected to contribute to future changes in climate.

Unlike air pollutants evaluated in federal NEPA reviews, sources for GHG emissions are typically evaluated globally or per broad-scale sector (e.g., transportation, industrial, etc.) and are not assessed at the local or project-specific level since the impacts are global and not localized or regional. In addition, from a quantitative perspective and in terms of both absolute numbers and emission source types, global climate change is the cumulative result of numerous and varied natural and human emission sources. Each source makes a relatively small addition to global atmospheric GHG concentrations. In contrast to broad-scale actions such as those involving an entire industry sector or a very large geographic area, it is unlikely that any individual transportation project would generate enough GHG emissions to significantly influence global climate change. It is for this reason that TxDOT discloses emission estimates for the entire Texas on-road transportation system rather than on a project-specific level.

4.15.1 Statewide Climate Change Assessment Summary

A qualitative assessment of potential global and national climate change projections was completed to evaluate the potential vulnerability of the Texas on-road transportation system to potential climate change impacts, typically projected between the years 2070 and 2100, unless otherwise specified. The analysis incorporates available information on historic and projected climate change impacts for the state of Texas from several sources. It should be noted that there are several major sources of uncertainty inherently included in the data source projections regarding climate change, such as the effects of natural variability, future human emissions, sensitivity to GHG emissions, and natural climate drivers. Data sources reviewed indicated it is uncertain how climate change impacts the frequency or severity of extreme weather, although climate change is thought to be connected to a potential for more severe storms. Table 4-35 shows the potential climate stressor baseline data and future projections for the State of Texas.

Table 4-35: Summary of Projected Climate Change Stressors for the State of Texas

Climate Variable	Source	Indicator	Existing and Projected Changes
Temperature	NCA[1]	Existing	93.1 to 104.4°F Temperature range of historical "7 hottest days" per year
		Projected	For RCP4.5, 0.74 to 6.08 days change and for RCP8.5 18.72 to 33.74 days in number of hottest days per year
	USGS[2]	Existing	70.6 to 8.59°F annual mean maximum temperature
		Projected	3.08 to 4.5°F (RCP4.5) to 4.64 to 6.25°F (RCP8.5) change in annual mean maximum temperature
Drought	NCA[1]	Existing	18.18 to 55.19 days for the number/range of consecutive dry days
		Projected	0.74 to 6.91 days predicted increase in the number of consecutive dry days
	USGS[2]	Existing	0.056 to 4.602 inches existing mean soil storage
		Projected	0.045 to 0.008 inches (RCP4.5), 0.071 to 0.008 inches (RCP8.5) predicted change in annual mean soil storage
	USGS[2]	Existing	0.419 to 3.069 inches in monthly evaporative deficit
		Projected	0.196 to 0.419 inches (RCP4.5), -0.6228 to 0.629 inches (RCP8.5) predicted change in annual mean evaporative deficit per month
Wet	NCA[1]	Projected	Less than 1 day decrease or increase (ranging from -0.077 to 0.7029 day) in the number of wet days per year between RCP4.5 and RCP8.5
Monthly Runoff	USGS[2]	Existing	0.036 to 1.24 inches (0.91 to 31.47 mm)
		Projected	-0.094 to 0.65 inches (RCP4.5), -0.221 to 0.035 inches (RCP8.5)
Wildfire Potential	TxWRAP[3]	Existing	TxWRAP provides current wildfire potential across Texas.
Sea Level Rise	IPCC[4]	Existing	From 1901 to 2010, historical global mean sea level rise was between 6.69 to 8.27 inches (0.17 to 0.21 meters) change. Maximum global mean sea level during the last interglacial period (129,000 to 116,000 years ago) was, for several thousand years, at least 16 feet (5 meters) higher than present and high confidence it did not exceed 32 feet (10 meters) above present.
		Projected	In the range 2081-2100, the likely range of global sea level rise relative to reference period of 1986 to 2005 is 1.05 to 2.07 feet (0.32 to 0.63 meters) for RCP4.5 and 1.48 to 2.69 feet (0.45 to 0.82 meters) for RCP8.5.

Climate Variable	Source	Indicator	Existing and Projected Changes
	NOAA[5]	Existing	Over the past 30 years global mean sea level rise has averaged approximately 0.12 inches/year (3 mm/year), based upon global tidal gauge data, or 3.54 inches over 30 years (90 mm per 30 years).
		Projected	By year 2100, 0.98 to 8.20 feet (0.3 to 2.5 meters) global sea level rise with intermediate scenario of 3.28 feet (1.0 meter). The intermediate option is slightly higher than the IPCC "likely range" scenario.
	USACE[6]	Projected	By year 2100, 0.6 to 4.9 feet (0.2 to 1.5 meters) global sea level rise.
	NCA[1]	Existing	The past century had a global average sea level rise of 8 inches.
		Projected	1–4 feet mean global average sea level is projected by the year 2100 with a plausible high of 3 to 4 feet. The study suggests decision-makers may wish to use a broader range of scenarios for risk based analysis within the range of 8 inches to as much as 6.6 feet.

Note: Future Climate Scenarios are based upon RCP4.5 and RCP8.5. RCP4.5 = ~650 ppm CO2E in 2100 representing a high degree of CO2 emission controls and RCP8.5 = ~1370 ppm CO2E in 2100 representing business as usual with little to no CO2 control measures implemented worldwide.

[1] (USGCRP, 2014) It projects climate data for the years 2041–2070.

[2] (USGS, 2016) The climate projection used was 2050–2074 compared to 1950–2005.

[3] (Texas A&M Forest Service, 2017) The Wildfire Risk Assessment Portal provides current fire intensity scale ranges from 1 (very low) to 5 (very high). The Portal does not project future year scenarios.

[4] (Stocker, 2013)

[5] (NOAA, 2017b) The local sea level rise projections from the NOAA report are available for all six global sea level rise scenarios as well as low, median, and high sub-scenarios.

[6] (USACE, 2014)

4.15.1.1 Adaptation and Resiliency Strategies

Resilience is the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions. Based on the climate stressors discussed in the technical report, adaptation and resiliency strategies may be considered during the post-NEPA design, construction, and/or maintenance activities for the Texas on-road transportation system to maximize limited transportation funds while considering potential extreme weather or climate change risk projections.

Additionally, TxDOT has identified climate stressors for each of the 254 counties in Texas. TxDOT plans to consider these data programmatically (i.e., during planning, hydraulic design, asset management, emergency response, and maintenance operations, including but not limited to pavement integrity).

4.15.2 Statewide On-Road GHG Analysis Summary

EPA's Motor Vehicle Emissions Simulator (MOVES2014 version) emissions model was used to estimate emissions. MOVES2014 does not account for the heavy-duty diesel CAFE standards for model years 2018–2029, which should further reduce the estimated emission projections. In the base year 2010, Texas on-road and fuel-cycle carbon dioxide equivalent (CO2E) emissions are estimated to be 171 million metric tons (MMT) per year; by 2040, emissions are estimated to be 168 MMT. Emissions are estimated to peak in 2017 at 176.6 MMT and reach a minimum in 2032 at 161.1 MMT. Changes to future regulations, market penetration for new vehicle and/or fuel technological advances, economics, and personal decisions regarding travel options could substantially lower future emissions.

In 2014, approximately 36,138 MMT of carbon dioxide (CO2) emissions were emitted worldwide, of which 175 MMT CO2E (0.49 percent of total global emissions) were due to Texas on-road and fuel-cycle emissions (World Bank, 2017). **Figure 4-21** provides a comparison of 2014 Texas (on-road transportation and fuel cycle CO2E and Texas CO2 emissions) and U.S. CO2E emissions to worldwide CO2 emissions. For the given year, the purple circle represents all vehicles traveling on existing roadways in Texas as well as vehicles traveling on newly constructed roadways. New construction roadways are a small percentage of total roadways in Texas. For example, the average annual lane addition in the current unified transportation program is 121 miles/year and our existing system is 677,577 miles.

Increasing congestion is a nationwide (Texas A&M Transportation Institute, 2015) and worldwide (INRIX, 2016) challenge. Congested travel delays caused U.S. drivers to waste more than 3 billion gallons of fuel in 2014 (versus 0.5 billion gallons of fuel in 1982) and cost the U.S. $160 billion in 2014. Less congestion equals reduced emissions. Reducing congestion while meeting the demands of population growth and economic expansion requires a multi-pronged approach that includes a mix of strategies, including new funding streams, new roadway construction, increased transit, better operations, flexible work schedules, and personal travel decisions.

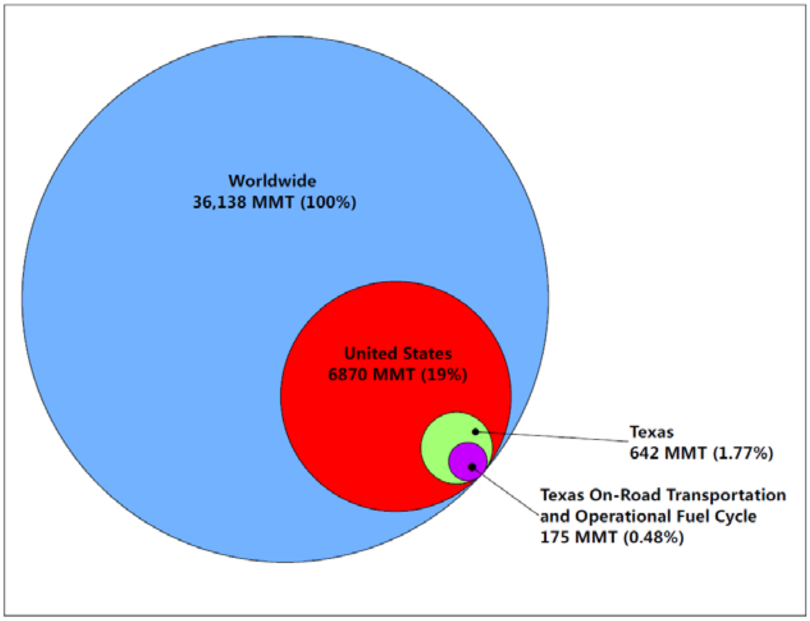

Figure 4-21. Comparison of 2014 Texas, U.S., and worldwide CO2 emissions.

(Source: Appendix O.)

4.15.2.1 Mitigation Measures

Strategies that reduce on-road GHG operational emissions fall under four major categories:

- federal engine and fuel controls under the Clean Air Act implemented jointly by EPA and USDOT, which includes CAFE standards;
- “cash for clunker” programs which remove older, higher-emitting vehicles from roads;
- TSM which improves the operational characteristics of the transportation network (e.g., traffic light timing, pre-staged wrecker service to clear accidents faster, or traveler information systems); and
- TDM which provides reductions in VMT (e.g., transit, rideshare, and bicycle and pedestrian facilities).

The majority of on-road emission reductions has been achieved through federal engine and fuel controls. Lesser reductions have been achieved through the other three options.

4.15.3 Conclusion

Climate change or extreme weather events may alter final project design following the conclusion of the environmental process, especially in areas subject to excess flooding and in coastal areas subject to potential storm surge or sea-level rise. From recent participation in FHWA Climate Change Resilience Pilots, both CAMPO, serving greater Austin, and the North Central Texas Council of Governments (NCTCOG, serving the greater Dallas-Fort Worth area) determined that the outcome of their analyses could be used for future scenario planning, but that the uncertainty in future climate projections precluded the use of the information for individual project funding decisions in their transportation plans. Such uncertainties also limit what data is reasonable for use under NEPA analyses.

4.16 Irreversible and Irretrievable Commitments of Resources

Construction of the proposed OHP Project would involve the commitment of natural, physical, human, and fiscal resources. The commitment of land to project right-of-way would require between approximately 74.58 and 75.19 acres depending on which of the alternative alignments is selected. This land includes residential and business properties, driveways, and natural areas. Land used for the proposed OHP Project would be considered an irreversible commitment during the period that the land is used for a transportation purpose. However, if a greater need arose, or if the highway is no longer needed, the land could be converted to another use. Presently, there is no reason to consider that such a conversion would be necessary or desirable.

A considerable amount of labor, fuel, and materials involving natural resources would be expended for construction of the proposed project, including aggregate, cement, asphalt, sand, and iron ore for steel products. These materials would be considered generally irretrievable once allocated to construction of the proposed project. As these resources are readily available and not in short supply, the use of these materials would not result in an adverse effect on the continued availability of any particular resource.

Construction would also require an expenditure of fossil fuels to supply construction equipment and worker vehicles. Although fossil fuel is an irretrievable resource, the amount expended during construction could be offset by the benefits of improved regional mobility that could improve fuel efficiency through a reduction of transportation travel times and traffic congestion.

The construction of the OHP Project would also require a substantial one-time expenditure of both state and federal funds. These funds, combined with the labor required to construct this highway, represent monetary commitments, and as such are irretrievable.

The decision to commit these resources for construction of the proposed project would be based on the concept that residents in the immediate area, region, and state would benefit by the improved quality of the regional transportation system. The benefits would include improved mobility and roadway safety, travel time savings on the improved transportation facility, and a transportation infrastructure designed to support population growth. The benefits would be expected to outweigh the commitment of resources.

4.16.1 No Build Alternative

The *No Build Alternative* would not involve improvements to the existing US 290/SH 71 roadway in the project area and would not use or dedicate natural or labor resources to the proposed project; therefore, there would be no irreversible or irretrievable commitment of resources.

4.17 Construction Impacts

4.17.1 Noise Impacts—Construction Phase

Heavy machinery is a major source of noise in construction; however, it is temporary and would normally only be experienced during daylight hours. None of the modeled noise receivers would be expected to be exposed to an inordinate amount of noise as a result of construction activities. If *Alternative A* or *Alternative C* is selected, the contractor would make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of construction equipment.

4.17.2 Air Quality Impacts—Construction Phase

During the construction phase of the OHP Project, temporary increases in PM and MSAT emissions may occur from construction activities. The primary construction-related emissions of PM are fugitive dust from site preparation, and the primary construction-related emissions of MSAT are diesel particulate matter from diesel-powered construction equipment and vehicles.

The potential impacts of PM emissions would be minimized by using fugitive dust control measures contained in standard specifications, as appropriate. The Texas Emissions Reduction Plan (TERP) provides financial incentives to reduce emissions from vehicles and equipment. TxDOT encourages construction contractors to use this and other local and federal incentive programs to the fullest extent possible to minimize diesel emissions. Information about the TERP program can be found at: http://www.tceq.state.tx.us/implementation/air/terp/.

However, considering the temporary and transient nature of construction-related emissions, the use of fugitive dust control measures, the encouragement of the use of TERP, and compliance with applicable regulatory requirements, it is not anticipated that emissions from construction of the OHP Project would have a significant impact on regional air quality.

4.17.3 Biological Impacts—Construction Phase

Vegetative communities in the OHP Project area would be removed or disturbed due to construction activities. This would result in habitat loss for resident and migratory species and could result in temporary removal of ground cover that helps prevent erosion. Disturbed areas would be restored, re-graded, and reseeded according to TxDOT specifications. BMPs to provide temporary erosion control during construction and permanent erosion control following construction would be employed.

4.17.4 Traffic Pattern Impact—Construction Phase

Traffic disruption would be expected during construction of either *Alternative A* or *Alternative C*. A detailed traffic control plan would be developed prior to construction to minimize traffic disruption and describe how access would be maintained for vehicles, pedestrians, and bicyclists using the facility during construction. Temporary increases in traffic congestion would be expected; however, access to adjacent properties would be expected to remain open as much as possible. Changes in traffic patterns would be communicated by roadside signs and displays; these changes would be communicated to emergency responders (police, fire, EMS, and others) and public service providers prior to implementing the change. Traffic control during construction would proceed in accordance with the *Texas Manual on Uniform Traffic Control Devices* and TxDOT's *Work Zone Standards*.

4.17.5 Hazardous Materials—Construction Phase

It is anticipated that contaminated soil and/or groundwater could be encountered during construction. Special provisions or contingency language would be included in the project's PS&E to handle hazardous materials and/or petroleum contamination according to applicable federal and state regulations.

Construction contractors should be instructed to immediately stop all subsurface activities in the event that potentially hazardous materials are encountered, an odor is identified, or significantly stained soil is visible. Contractors and maintenance personnel should be instructed to follow all applicable regulations regarding discovery and response for hazardous materials encountered during the construction process.

4.17.6 Water Resources—Construction Phase

Minor impacts to water resources during construction may occur, including permanent fill impacts to waters of the US. However, controls and BMPs detailed in the SW3P and WPAP will be used to minimize, to the extent practicable, the discharge of pollutants in stormwater associated with construction activity and (certain) non-stormwater discharges. The SW3P will include measures to control erosion and limit the discharge of pollutants to surface waters and groundwater. Erosion control measures may include, but are not limited to, the installation of silt fencing, mulching, erosion control blankets, and berms.

4.17.7 Geologic and Soil Impacts—Construction Phase

Geologic resources within the project area are anticipated to receive minor impacts from *Build Alternative* construction activities. Geologic units located near the ground surface may be exposed, resulting in erosion of those areas. Erosion effects would be minimized by utilizing preventive BMPs including dikes, berms, mulching, erosion control blankets, and other protective measures.

Construction activities proposed for the *Build Alternatives* within the project area would result in a range of effects to existing soils. The potential for soil compaction, erosion, or sedimentation would increase along with most construction activities. BMPs, along with other erosion and sediment control measures, would be utilized to minimize erosion and soil loss during these activities. These proposed actions would result in a reduction of project impacts to area soils.